Vickers Valiant

The First of the V-Bombers

Eric B Morgan

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Title page: **WB210, the first Valiant prototype.**

Below: **XD823 performed the third 'Grapple' test and was also the first Valiant to be painted with 'anti-flash' white paint.**

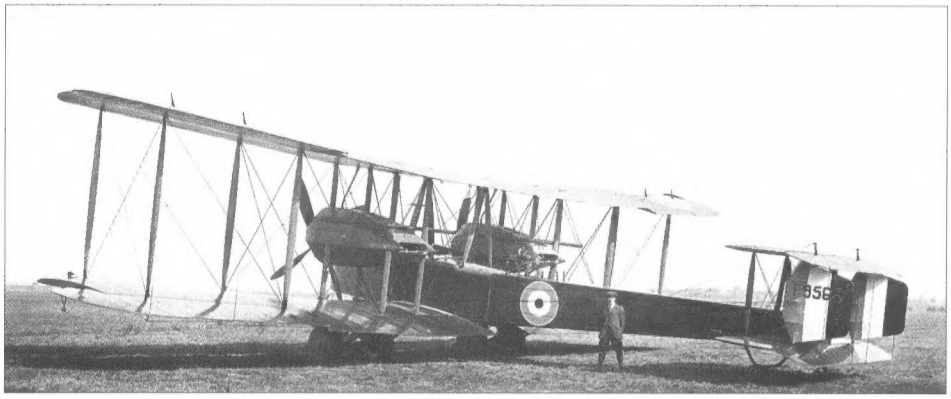
Contents

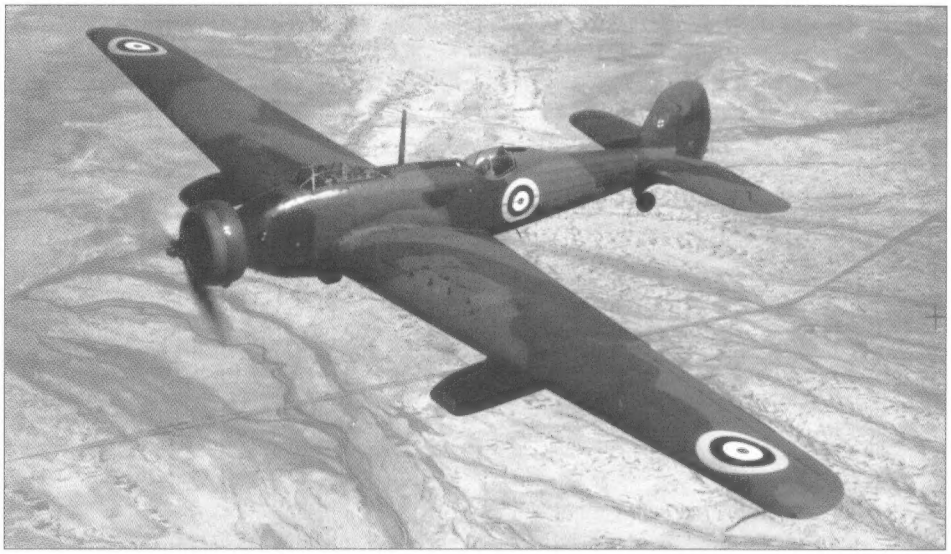
Introduction

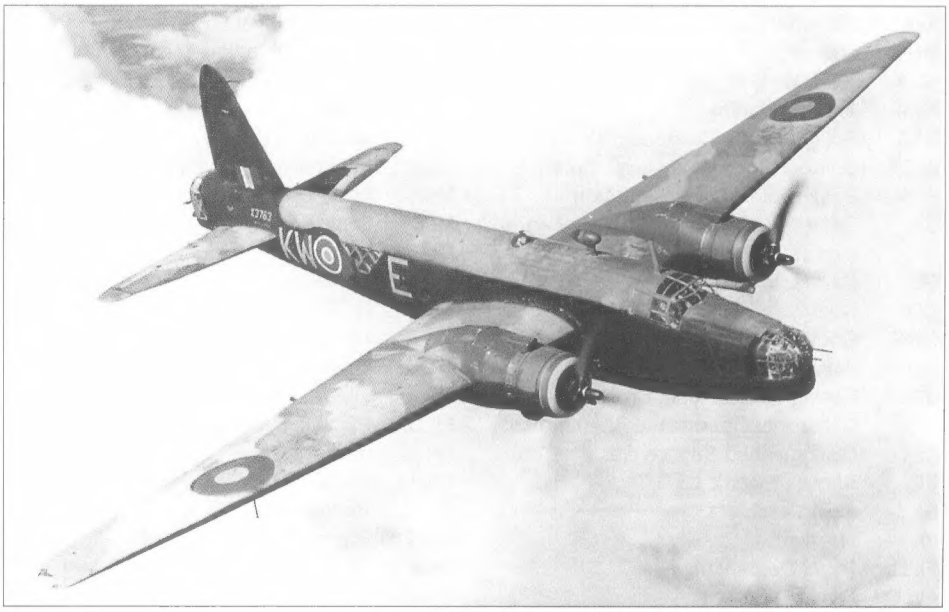
Vickers began life as Vickers, Sons and Maxim and in 1908, as the air became used for flying, the firm became interested in this new art when it was contracted by the Admiralty to build a large rigid airship. This was named 'Mayfly' but it was not a success because, during its first mooring tests at Barrow in 1911, it suffered severe structural failure, broke its back and was written off. In the same year Vickers established an aviation department to design and build aeroplanes and also built a flying school at Brooklands. A small part of their works at Erith, Kent, was switched to aircraft construction and a drawing office was established at Vickers House, Broadway, Westminster; this was moved to Vickers at Crayford in 1914. After this small beginning the advent of World War One in 1914 took Vickers onto the manufacture of thousands of fighters and reconnaissance aircraft, although most of them were made at Erith to other firms' designs. In 1915 production was expanded to Weybridge and here the firm built BE.2s and SE.5As.

In July 1917 Vickers was asked by the Air Board to design a long-range bomber so that Berlin could be brought within bombing range as a counter to German raids over London. The prototype of this aircraft was the Vickers FB.27, later called the Vimy, which, when it first flew on 30th November 1917, began a line of bomber production that would be carried through to the Valiant four-jet bomber of 1951. It was the Vimy that eventually pioneered long-distance flying – in June 1919 it became the first to fly across the Atlantic direct from Newfoundland to Ireland and on 10th December it arrived in Australia having flown 11,130 miles (17,908km), in stages, from England, once again the first to achieve this feat. During 1920 a Vimy flew overland in stages to South Africa.

Vickers' next product was the Vernon, a 12-seat transport and ambulance that was later adapted to carry bombs and then in the early 1920s this was followed by the Victoria bomber transport and the Virginia bomber. These became the Vickers inter-war bombers and







Vickers Vimy F9569, one of the first prototypes, seen at Brooklands aerodrome together with a foremen to highlight the aircraft's size.

Vickers Wellesley L2645 fitted with pods under each wing, a store that was actually earmarked for the Valiant for the carriage of bombs or flares.

Vickers Wellington III X3763 as KW-E of 425 Squadron.

they lasted almost to the second conflict. Vickers continued to pursue the heavy bomber theme but received no orders for the twin-engined B.19/27 and the four-engined Type 163.

In the meantime Barnes Wallis, as Chief Designer Structures, had brought new ideas including geodetic construction which he applied to a new very long-range monoplane bomber; this became the Wellesley and the first production machine flew on 30th January 1937. On 7th July 1938 a flight of four Wellesleys flew 4,300 miles (6,919km) in 32 hours from Cranwell to the Persian Gulf before doubling back and landing at Ismailia, Egypt. From 5th November two Wellesleys out of the three that set out flew 7,157.7 miles (11,517km) from Ismailia to Darwin in 48 hours to create a new World Distance Record. The type was used to bomb the Italians in Abyssinia during 1941.

The next Vickers bomber was the twin-engined Wellington to B.9/32 which shared the same geodetic construction as the Wellesley and the first production machine was flown from Weybridge on 23rd December 1937. A total of 10,461 were built and Vickers were still turning them out at the end of World War Two. A companion to the Wellington was the Warwick which was designed at the same time but its manufacture was delayed. Eventually 845 were built and they were used for air-sea rescue duties. The final geodetic bomber was the four-engined Windsor, the first prototype flying on 12th February 1944 from Wisley. An order was placed for 300 with the intention to use them to bomb Japan but when the war ended many production programmes were cancelled and the Windsor was a victim of these cutbacks.

In the early post-war period Vickers concentrated on civilian passenger-carrying aircraft and its Viking first flew on 22nd June 1945. However, by now, Vickers had so much experience in bomber design that when thoughts first turned towards another bomber, in the form of specification B.35/46, the company was very interested. Indeed it was ideally placed to produce a competitive project.

Acknowledgements

I must thank Vickers Armstrongs (Aircraft) Ltd for employing me for over 20 years and for providing me with an ideal situation where I could study the aircraft types that the company had built, which of course included the Valiant jet bomber, and to talk to the managers and workers at the Weybridge works.

The following were also very helpful in the completion of this manuscript:
A W Kitchenside, who worked on the aircraft and has helped a lot in the Archives Department at the Brooklands Museum. There is now a very good collection of Valiant documents available for perusal at the Museum.

Phil Butler for his help with the list of serial numbers. My information came from the company's aircraft history cards which are a lot more comprehensive that the Air Ministry's but they do not provide much detail for each aircraft's service history. Phil has provided the material that fills the gaps.

Tony Buttler for helping to edit the book and for his enthusiasm on several other matters; BAE Systems for the colour photographs; Walter Carter for the nuclear weapons pictures; Dennis J Corley for his assistance with the nuclear deterrent; John Lewer of the Gloucestershire Aviation Collection for his memories and his notes about WP217's spar failure, and P Williams for his Australian 'Grapple' shots.

Eric B Morgan 2002

Abbreviations and Acronyms

A&AEE	Aeroplane & Armament Experimental Establishment
AFB	Air Force Base (USAF)
AFC	Air Force Cross
arr	arrived
ATU	Air Trials Unit
AVM	Air Vice Marshal
BAC	British Aircraft Corporation
BCDU	Bomber Command Development Unit
BJSM	British Joint Services Mission
Cat.	Category of damage (1 to 5) of an aircraft
CB	Contracts Branch
CO	Commanding Officer
CWP	Contractor's Working Party
d/d	delivered
DFC	Distinguished Flying Cross
DOR	Director of Operational Requirements
DSO	Distinguished Service Order
EE	English Electric
FA	Flying accident
f/f	first flight
Flt Lt	Flight Lieutenant
Flg Off	Flying Officer
FR	Flight Refuelling
HC	High capacity
HE	High explosive
HRH	His/Her Royal Highness
HS	Hawker Siddeley
IAS	Indicated air speed
kt	kiloton
MC	Medium capacity
MFS	Marshalls Flying School
MoA	Ministry of Aviation
MoS	Ministry of Supply
Mt	Megaton
MU	Maintenance Unit
NBS	Navigation and Bombing System
nm	nautical miles
OCU	Operational Conversion Unit
OR	Operational Requirements
Plt Off	Pilot Officer
PR	Photographic Reconnaissance
PRU	Photographic Reconnaissance Unit
R	Repairable
RATOG	Rocket assisted take-off gear
RoS	Repairable on Site
RAAF	Royal Australian Air Force
RAE	Royal Aircraft Establishment
RCM	Radio countermeasures
RNZAF	Royal New Zealand Air Force
RR	Rolls-Royce
RRE	Royal Radar Establishment
RS	Radio School
SAC	Strategic Air Command
SBAC	Society of British Aircraft Constructors
Sqn Ldr	Squadron Leader
SoC	Struck off Charge
SoTT	Schools of Technical Training
Sqdn	Squadron
t:c	thickness/chord ratio
TI	Trial installation
TRE	Telecommunications Research Establishment
USAF	United States Air Force
u/w	under wing
V-A	Vickers Armstrongs (Aircraft) Ltd
VD	Design velocity
Wg Cdr	Wing Commander
WRE	Weapons Research Establishment

Beginnings and Crystallisation

B.35/46 and B.9/48

Britain's first jet bomber was the English Electric Canberra built to specification B.3/45. The Air Ministry did not ask for another bomber during 1945 but in 1946 a surge of specifications was issued searching for improved aircraft in many roles (47 different documents in all). The first bomber specification was B.14/46, dated 11th August 1946, for a medium-range Avro Lincoln replacement which was issued on 26th September to cover a Shorts design that was eventually built as the Sperrin. This requirement asked for a radius of action of 1,500 nautical miles (2,778km) with a bomb load of 10,000 lb (4,536kg) and a ceiling over the target of 45,000ft (13,716m); the range or bomb load could be reduced to increase the other. There was to be no armament since the aircraft was to rely on its speed and, for high altitude flying, it was to have a pressure cabin with oxygen for a crew of five and full-endurance flying at 20,000ft (6,096m). The Sperrin was the result of some private studies first sponsored by the Air Ministry in February 1945 and two prototypes were ordered as an Interim Insurance Bomber against failure of the B.35/46 aircraft described below.

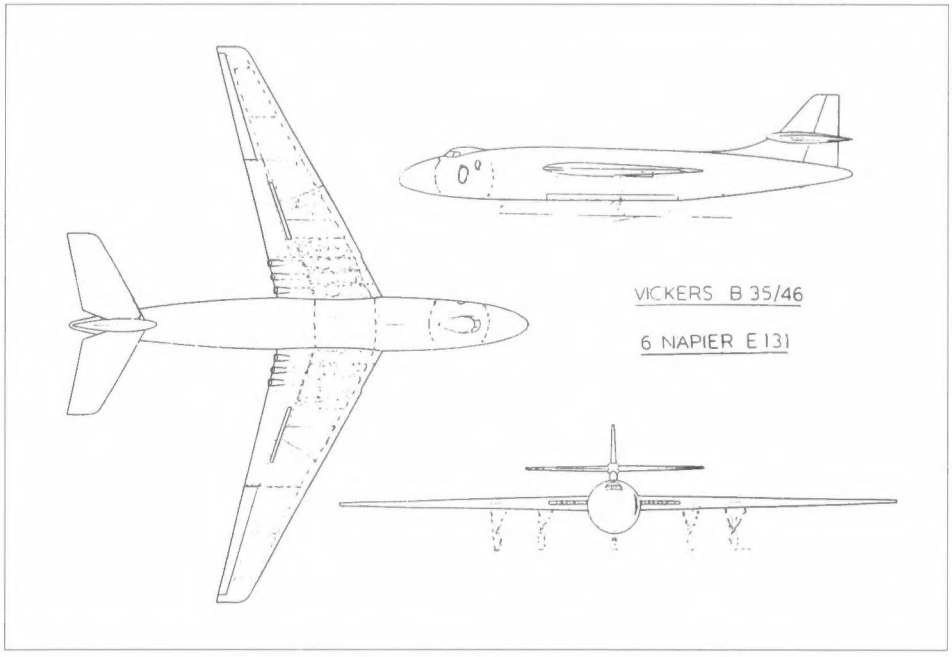
The Air Ministry's optimum nuclear bomber was covered by specification B.35/46 which was issued to industry on 24th January 1947 together with Operational Requirement (OR) 229. Again calling for a medium-range aircraft, the requirements were similar to B.14/46 but included a cruising speed of 575mph (925km/h) at heights between 35,000ft and 50,000ft (10,668m and 15,240m), a still-air range of 3,350nm (6,204km) and a 10,000 lb bomb load. However, over short ranges the bomb load could be a maximum of 20,000 lb (9,072kg) composed of two 10,000 lb concrete-piercing, two 10,000 lb HC (high capacity), four 5,000 lb (2,268kg) HC, 20 1,000 lb (454kg) MC (medium capacity) or one Special Bomb (the atomic weapon to OR.1001 codenamed Blue Danube). It was this specification that would give Britain its V-Bomber force.

Six companies tendered designs to the Air Ministry: Armstrong Whitworth, Avro, English Electric, Handley Page, Short Brothers and Vickers. A meeting chaired by Stuart Scott-Hall of department P/DTD(A) was held at the Ministry of Supply on the morning of 28th July 1947, the purpose of which was the following:

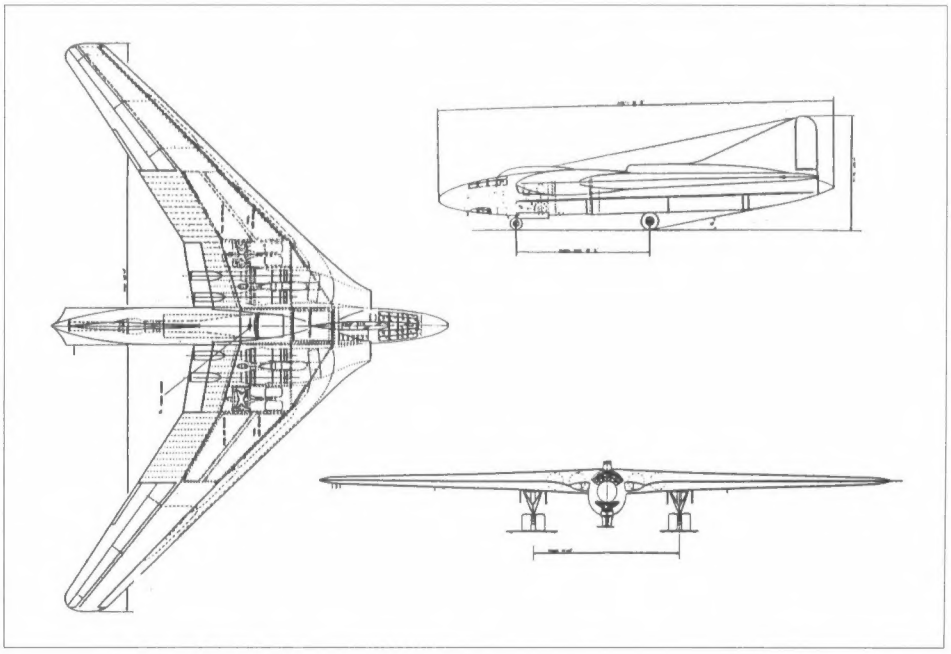
a. To select the best type or types from the Shorts S.B.1, Armstrong Whitworth AW.56, Handley Page HP.80 and Avro 698 designs.
b. To consider whether any change to the B.14/46 order was necessary in the light of the English Electric and Vickers tenders.

(The Vickers project had been rejected to B.35/46 because it did not meet the performance requirements but the second point would assess if either of the Vickers and English Electric designs might be a better alternative to the Shorts interim bomber.)

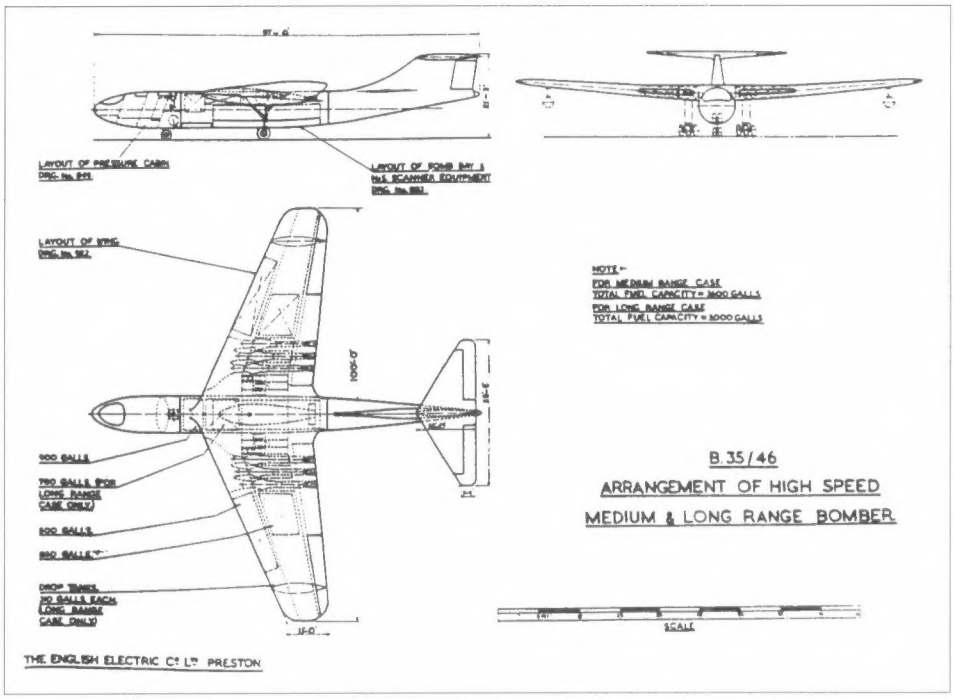
The Assistant Chief of Air Staff (Technical Requirements) (ACAS[TR]), Air Vice Marshal Boothman, explained 'that a bomber having



Vickers drawing 45391 Sheet 1. Bomber project to B.35/46 with six Napier E.131 engines (May 1947).



General arrangement drawing of the Armstrong Whitworth AW.56 to B.35/46.



Left: **The English Electric Bomber to B.35/46 with a high wing and no sweepback.**

Below: **Variant of Vickers' B.35/46 Medium-Range Bomber fitted four Metropolitan-Vickers F.9 jet engines. It has the same wing and fuselage as the first drawing on the previous page and is dated May 1947 (drawing 45291 Sheet 13).**

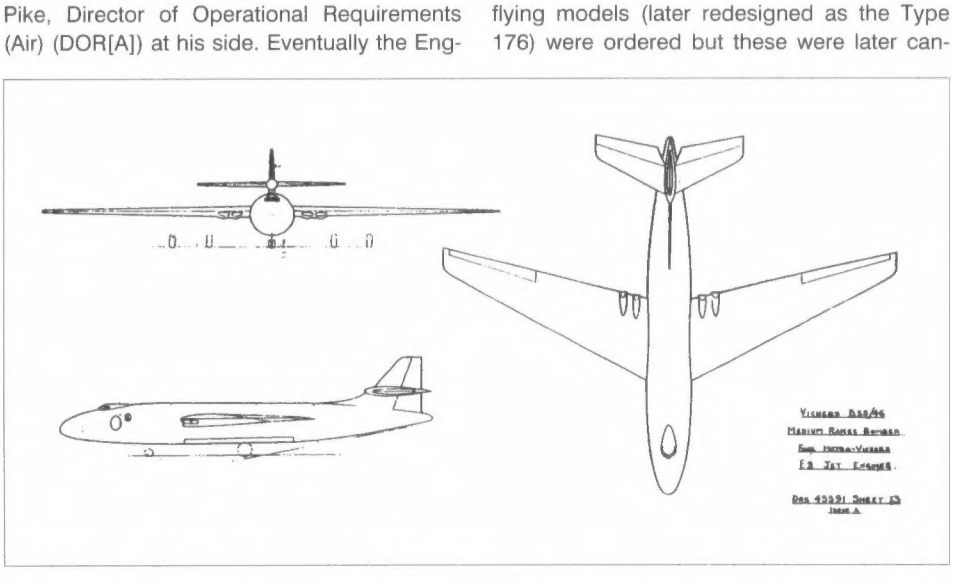
the greatest possible chance of penetration was vital to national defence and that there should be no hesitation in proceeding boldly with the most promising design'. Air Commodore C A Bell placed the Handley Page project first, Avro second and Armstrong Whitworth third while H G Bloss stated that all three of these firms needed work at this time. On a vote the Avro 698 came first, HP.80 second and AW.56 third and the meeting agreed that an order should be placed for the Avro project together with a flying scale model, while RAE should undertake high-speed tests on Handley Page's wing planform after which a decision would be made between it and Armstrong Whitworth's design.

Later in the day a second meeting discussed the relationship of the Vickers and English Electric B.35/46 tenders to the Shorts B.14/46 insurance bomber. This was chaired by J E Serby, Director of Military Aircraft Research and Development (DMARD), with A/Cdr Thomas Pike, Director of Operational Requirements (Air) (DOR[A]) at his side. Eventually the English Electric design was disregarded because the firm had based its design on a diving speed of only 350 knots (649km/h) rather than the 435 knots (806km/h) required by the specification. The improved performance of the Vickers design was largely due to its additional thrust and lower wing loading. The Short aircraft was at present cruising just inside its critical Mach Number at maximum thrust and, therefore, the effect of any sweepback would not increase its speed unless the thrust was also increased. It was agreed that the Short B.14/46 prototypes should continue as ordered but their engine layout should be improved.

As a result of the extra tunnel testing, prototypes of both Avro's 698 and Handley Page's HP.80 were eventually ordered (together with scale model aircraft called the Avro 707 and HP.88), while AWA's project narrowly missed out. Earlier, Bristol had offered a long-range bomber project called the Type 172 to another requirement, OR.230, and two Type 174 scale flying models (later redesigned as the Type 176) were ordered but these were later cancelled. Shorts' S.B.1 had featured highly swept-back wings and a new concept of all-moving wing tips (the 'aero-isoclinic' wing designed by Geoffrey Hill) and the firm went on to build a glider to test this shape which shared the same S.B.1 designation (later it was fitted with two small jet engines and retitled S.B.4 Sherpa).

B.35/46 was very advanced and it was envisaged that swept-back wings were a minimum requirement while improved metals, tyres etc would also be required. With the additional research that this needed, the Air Ministry assumed that it would take some time before there would be any results and, since it was in a hurry to get a high speed medium bomber, the Air Staff and MoS agreed in September 1947 that it might be desirable to order a third type to the same specification but with certain relaxations on performance to allow a less advanced design to be employed. In January 1948 approval was sought for a further interim bomber and in March OR.239 was issued for what was termed an 'Insurance' aircraft. Although Shorts was already designing the B.14/46 (Sperrin) this was a conventional straight-wing jet bomber. The Vickers tender to B.35/46 was an improvement over the Sperrin while its development time was comparable and so Vickers were advised to submit a revised tender to this new requirement along with Armstrong Whitworth and English Electric.

English Electric's project was a high-wing design with six Napier or Armstrong Siddeley axial-flow turbojets in wing root fittings. It had a span of 100ft (30.5m) and wing area 2,000ft² (186m²) and it could carry a 20,000 lb (9,072kg) bomb load. All-up-weight would have been about 84,000 lb (38,102kg) and the estimated maximum speed was 590mph (949km/h), range 3,900 miles (6,275km) and service ceil-



Illustrations on the opposite page:

Top: **The first known drawing of the Vickers B.35/46 showing compound sweep on the leading edge and a two-wheel main undercarriage (October 1947).**

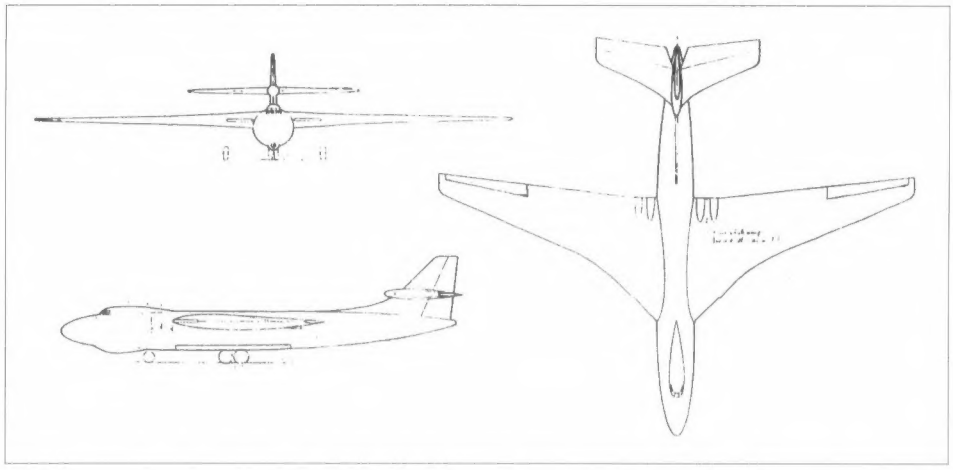
Bottom: **A set of drawings showing proposed future developments to the B.35/46's wing. The inner planes, fin and rudder are identical, only the hatched portions would be redesigned. Aircraft 1: Aspect Ratio 5.55, Sweepback 20° (outer plane); Aircraft 2: Aspect Ratio 5.0, Sweepback 30° (outer plane); Aircraft 3: Aspect Ratio 3.5, Sweepback 42° (whole wing).**

Vickers B.35/46 Technical Data (Manufacturer's Estimates)

Dimensions		
Span	137ft 0in	41.8m
Length	111ft 0in	33.8m
Height	30ft 6in	9.3m
when 'bombing up'	33ft 3in	10.1m
Wheel track		
inner	37ft 0in	11.3m
outer	58ft 0in	17.7m
Wing		
root chord	25ft 8in	7.8m
root t/c ratio	13%	
tip chord	6ft 10in	2.1m
tip t/c ratio	12%	
mean t/c ratio	12.6%	
wing section	Vickers High Speed	
sweepback on 25% chord line	25°	
Areas		
wing (net)	2,015ft²	187.4m²
wing (gross)	2,350ft²	218.6m²
tail and elevator	44ft²	4.1m²
fin and rudder	240ft²	22.3m²
Weights		
Structure	35,200 lb	15,967kg
Powerplant (six E.131)	14,900 lb	6,759kg
Fuel components	2,200 lb	998kg
Power services	2,310 lb	1,048kg
Cabin pressure system	500 lb	227kg
Protection (for icing or fire)	1,600 lb	726kg
Bomb installation	2,050 lb	930kg
Equipment	1,900 lb	862kg
Removable load		
(inc 3 cabin parachutes)	4,700 lb	2,132kg
Bombs	10,000 lb	4,536kg
Fuel 3,940gals (17,915 litres)	29,050 lb	13,177kg
Take-off weight	115,000 lb	52,164kg
Landing weight	81,900 lb	37,150kg
Performance at a mean weight of 92,300 lb (41,867kg)		
Max speed at max power		
at sea level	495 knots	917km/h
at 10,000ft (3,048m)	507 knots	939km/h
at 20,000ft (6,096m)	513 knots	951km/h
at 30,000ft (9,144m)	511 knots	947km/h
at 40,000ft (12,192m)	503 knots	932km/h
at 50,000ft (15,240m)	490 knots	908km/h
Rate of climb		
at sea level	4,000ft/min	1,219m/min
at 10,000ft (3,048m)	3,450ft/min	1,052m/min
at 20,000ft (6,096m)	2,950ft/min	899m/min
at 30,000ft (9,144m)	2,440ft/min	744m/min
at 40,000ft (12,192m)	1,600ft/min	488m/min
at 50,000ft (15,240m)	400ft/min	122m/min
Service ceiling	52,000ft	15,850m
Range with 10,000 lb of bombs		
at 480 knots (889km/h)	3,350nm	6,208km

Powerplant

Six Napier E.131 jet engines rated at 5,055 lb (22.5kN) maximum thrust for take-off and climb.



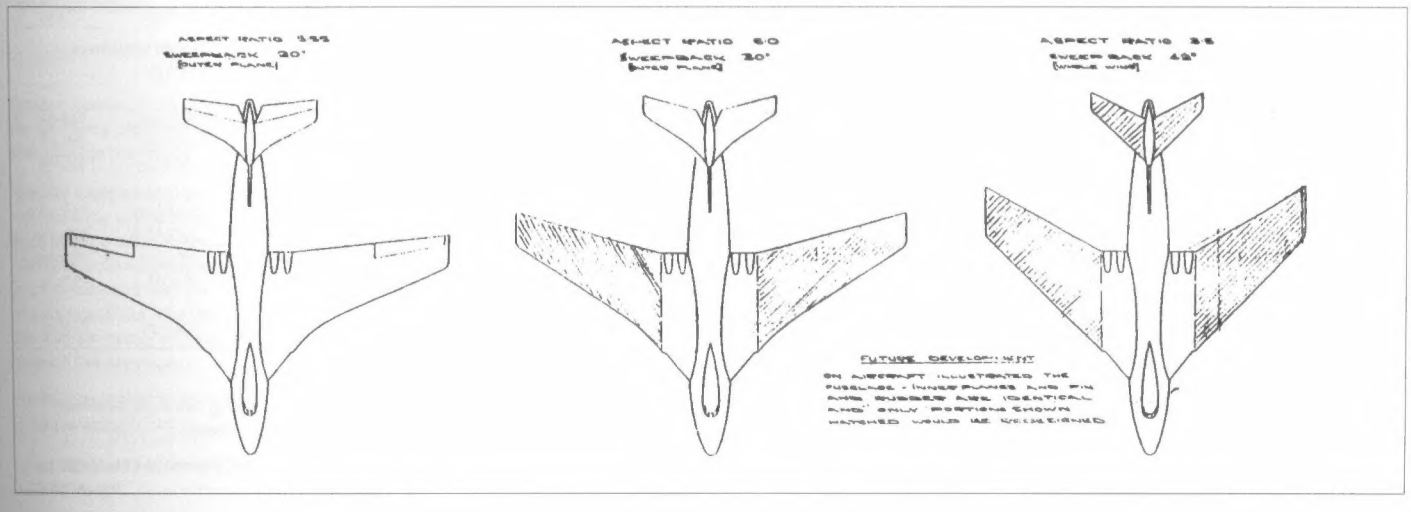
ing 50,000ft (15,240m). The Air Ministry made up its mind that the Vickers tender gave the best option with, in its opinion, a better equipment layout, even though English Electric's project had the higher estimated speed. By now English Electric was, of course, also heavily committed with Canberra work.

However, back in July 1947 the Royal Aircraft Establishment (RAE) had shown some dissatisfaction with the Vickers B.35/46 proposal because it estimated that the all-up-weight was 117,500 lb (53,298kg) compared to the design weight of 115,000 lb (52,164kg) and the height achieved after two and a half hours flying would be 44,700ft (13,625m) compared to the figures of 50,000ft (15,240m) claimed as possible by Vickers and 45,000ft (13,716m) as the 'height' actually achieved in tunnel tests. The most important disagreement, however, centred on critical Mach number.

Vickers claimed a cruising speed of up to 480 knots (890km/h, Mach 0.84) for its 13% thick 25° swept back wing, whereas 452 knots (838km/h, Mach 0.79) was thought to be the maximum that could be achieved in practice. In order to reach even this speed the cruising height and range would have to be reduced and it was estimated that a reduction of cruise speed to 430 knots (797km/h) would result in gains of 90nm (167km) in range and 1,400ft (427m) in height. At 452 knots (838km/h) cruise the manoeuvring qualities of the aircraft were expected to be adequate – minimum radius of turn was 3,300 yards (3,018m). The ditching characteristics were expected to be good because the shape of the fuselage was favourable and no flooding of the nose should take place, provided that the bomb doors did not collapse. RAE also suggested to Vickers that a thinner wing could be fitted to reduce drag and increase speed.

At an Air Ministry Design Study Conference held on 15th January 1948, new specifications were outlined for the 'Backup Bomber' that included a smaller bomb load of 10,000 lb (instead of 20,000 lb), radius of action 1,500 miles (2,414km) and a limited speed. The choice between English Electric and Vickers might be governed entirely by the need for keeping Vickers employed and the Chairman (Scott-Hall) thought that the issue of retaining Vickers in the industry was of paramount importance. Both firms were asked to send in further proposals so that a decision could be made based on technical merit only.

Vickers had already prepared a design study under Ref. 85490 Vickers B.35/46 (Revised) with a new wing, a modified fuselage and four Armstrong Siddeley Sapphire turbojets, which was submitted to the Air Ministry in November 1947. Vickers had changed the shape of its B.35/46 planform from a straight-taper wing of 25° sweepback to one of 20° sweep over the outer half and 37° over the root end. The firm



reasoned that a delay in the onset of compressibility was gained by the high sweepback at the root while the satisfactory stalling and handling properties associated with low sweepback were retained by the lower values over the outer plane. The effect of this change was to push the cruise speed using four Sapphires to approximately 10 knots (18.5km/h) above the figure previously estimated in the original B.35/46 design using six Napier E.131 units.

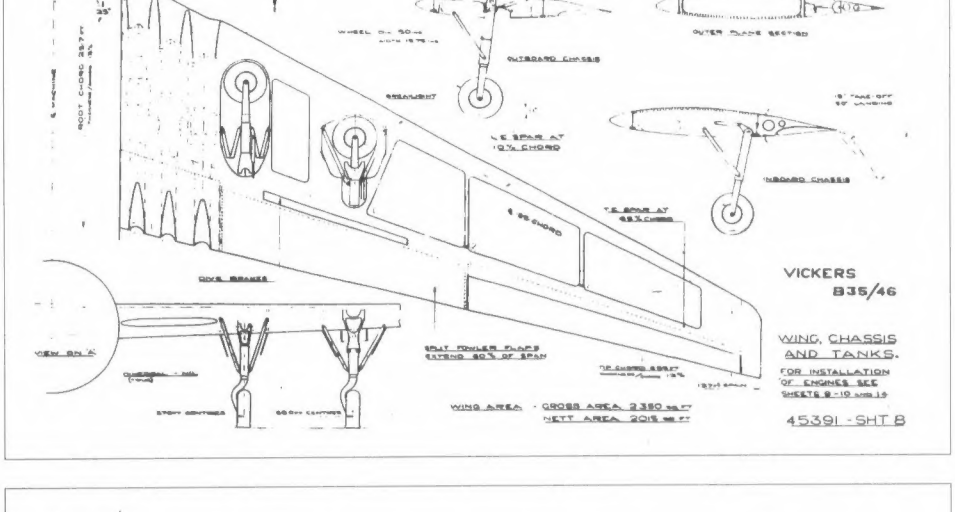
The Air Staff's concession to a reduced bomb load permitted a smaller fuselage of maximum diameter 11ft 3in (3.43m) instead of 13ft (3.96m) which saved 5,000 lb (2,268kg) in weight. If the cabin jettisoning requirement was deleted it would save another 600 lb (272kg) while another new feature was the addition of the bomb aimer's position underneath the pilot (this was to appear in all Valiants). Vickers noted that the estimated time of 195 weeks from receipt of order to prototype flight first proposed for the original B.35/46 was still valid; based on an order being placed by the end of 1947, a prototype flight could be expected in September 1951 with production deliveries commencing early in 1953. (Vickers did not actually receive an order until the 2nd February 1949, despite having pressed for one the previous November, but the first prototype flew on 18th May 1951 because the company knew it would get an order and consequently used its own resources to initiate the aircraft's construction and keep the project moving.)

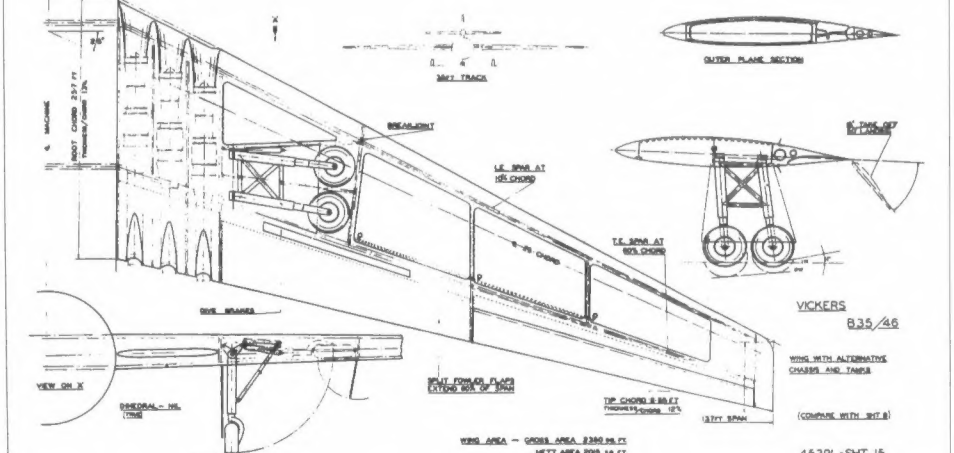
By adding another 1,730gals (7,866 lit) of fuel in the fuselage centre-section, this new design would also meet the long-range bomber requirement OR.230, the extra supply increasing the still-air range to 4,350nm (8,061km) and all-up-weight to 124,600 lb (56,519kg). The revised project was discussed at the Air Ministry on 23rd March 1948 where both Vickers' and the Air Ministry's experts concluded that the increased difficulties involved with this design might mean a delay of about two years in its development, which would bring it into the same time scale as the Avro and Handley Page aircraft.

The project was further refined in early February 1948 when both English Electric and Armstrong Whitworth were still pushing versions of their designs. However, the Vickers project was the most favoured and in March the Treasury approval was given to order two prototypes, while in April Vickers was instructed to proceed with preliminary design. Go-ahead had now been given for four medium bomber types but any production plans for the Short S.A.4 Sperrin were ended by the acceptance of the Vickers aircraft, the company receiving instructions to proceed with two prototypes on 16th April.

Meetings now followed between the Air Staff and the Ministry of Supply (MoS) to agree the performance requirements and parameters of a new Specification, B.9/48 (a relaxed form of OR.229), that would have to be met by Vickers' aircraft. The document was finally issued on 19th July 1948 and called for the following:

a. To avoid ground-launched weapons, height over the target was to be greater than 47,000ft (14,326m);
b. Cruising speed was to be at least 465 knots (862km/h) with a landing approach speed not exceeding 120 knots (222km/h);
c. Take-off was to be 1,600 yards (1,463m) or less using rocket assistance or reheat if necessary;
d. Bomb load was to to be 10,000 lb (4,536kg), or 20,000 lb (9,072kg) at short range;
e. Range to be greater than 3,350nm (6,208km);
f. Equipment fitted to include H2S Mk.9 radar and the NBC Mk.2 (Navigation and Bombing Computer) bombing aid, Gee, tail warning and RCM (Radio Countermeasures);
g. If possible a jettisonable pressure cabin was to be fitted.





Technical Details for the Revised B.35/46 design (Manufacturer's Estimates)

Dimensions		
Span	136ft 3in	41.5m
Length	114ft 6in	34.8m
Height	30ft 6in	9.3m
Wheel track	27ft 0in	8.2m
Gross wing area	2,490ft²	231.6m²
Weights		
All-up-weight		
(Avon or Sapphire engines)	110,000 lb	49,896kg
Performance with four 7,000 lb (31.1kN) thrust Sapphires at a mean weight of 85,500 lb (38,783kg)		
Max speed		
at 30,000ft (9,144m)	520 knots	964km/h
at 40,000ft (12,192m)	510 knots	945km/h
at 50,000ft (15,240m)	500 knots	927km/h
Rate of climb		
at sea level	5,230ft/min	1,594m/min
at 20,000ft (6,096m)	2,980ft/min	908m/min
at 40,000ft (12,192m)	950ft/min	290m/min
at 45,000ft (13,716m)	450ft/min	137m/min
Service ceiling	48,500ft	14,783m
Range with 10,000 lb of bombs		
at 480 knots (889km/h)	3,350nm	6,208km
Performance with four 6,500 lb (28.9kN) thrust Avons at a mean weight of 84,900 lb (38,511kg)		
Max speed		
at 30,000ft (9,144m)	507 knots	939km/h
at 40,000ft (12,192m)	506 knots	938km/h
at 50,000ft (15,240m)	490 knots	908km/h
Rate of climb		
at sea level	3,320ft/min	1,011m/min
at 20,000ft (6,096m)	1,930ft/min	588m/min
at 40,000ft (12,192m)	500ft/min	152m/min
Service ceiling	45,000ft	13,716m
Range with 10,000 lb of bombs		
at 470 knots (871km/h)	3,350nm	6,208km

The individual wheels of the B.35/46's four-wheel main undercarriage.

The tandem wheel arrangement used later on the Valiant.

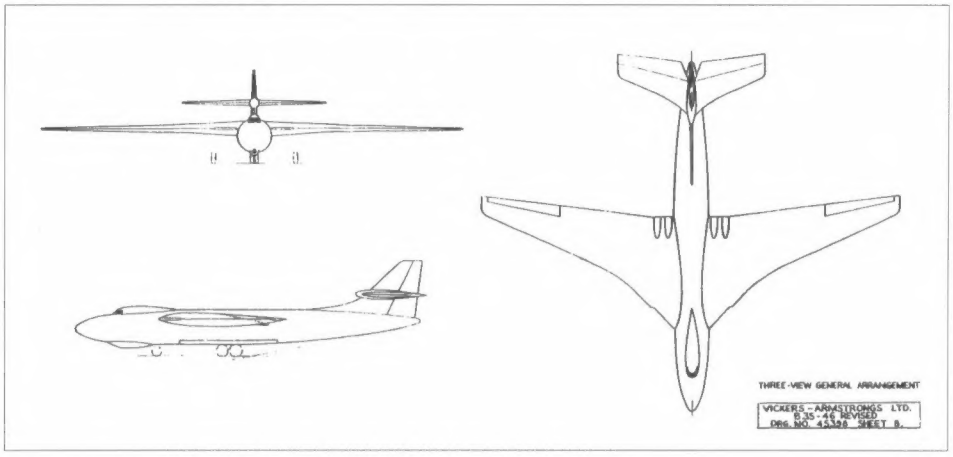
Technical Data Vickers brochures 88008 and 88009 August 1948 (Manufacturer's Estimates)

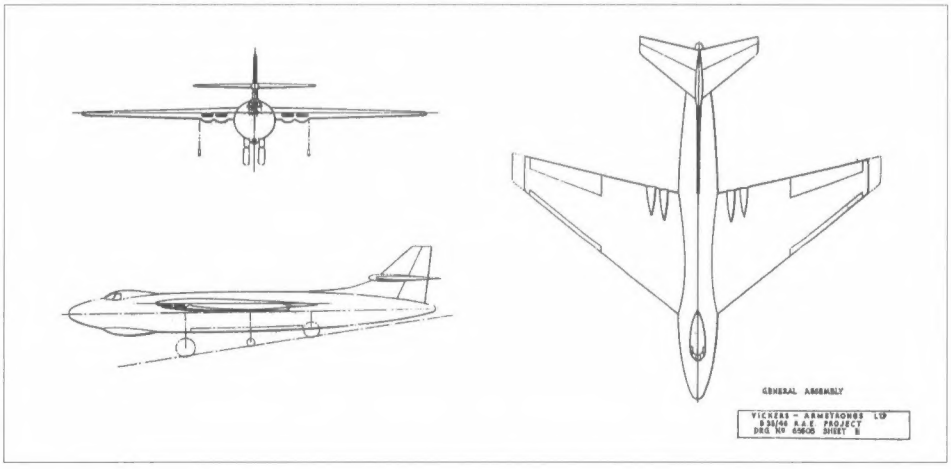
Four 6,500 lb (28.9kN) Rolls-Royce Avons ('developed' engines giving 7,500 lb [33.3kN] could be substituted)

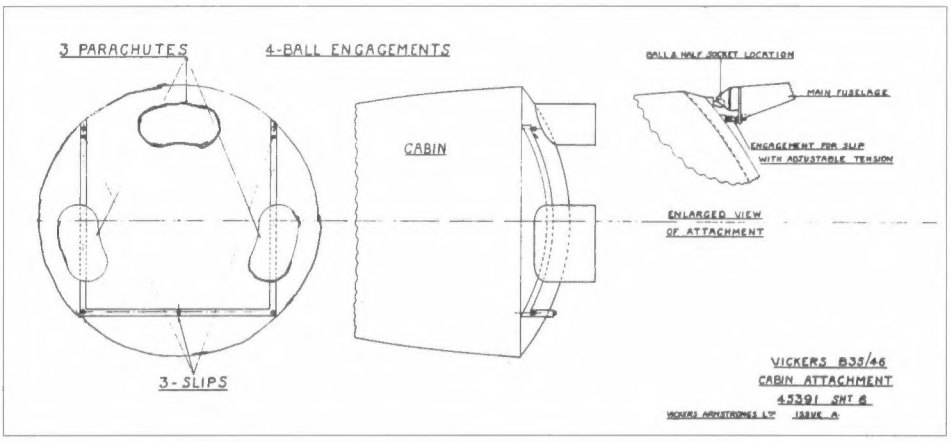
Dimensions		
Span	113ft 3in	34.5m
Length	108ft 2½in	33.0m
Height	30ft 6in	9.3m
Wheel track	28ft 0in	8.5m
Fuselage diameter	11ft 2¼in	3.41m
Wetted area	2,740ft²	254.8m²
Gross wing area	2,354ft²	218.9m²
Aspect ratio	5.45	
Wing section	Vickers High Speed	
Weights		
Tare	54,250 lb	24,608kg
Basic operational with five crew	57,170 lb	25,932kg
Bomb load	10,000 lb	4,536kg
Fuel 5,370gals (24,417 litres)	43,500 lb	19,732kg
Take-off weight	111,000 lb	50,350kg
Estimated Performance with Four Avons		
Max speed		
at 30,000ft (9,144m)	515 knots	954km/h
at 40,000ft (12,192m)	500 knots	927km/h
at 47,500ft (14,478m)	470 knots	871km/h
Rate of climb		
at sea level	2,900ft/min	884m/min
at 10,000ft (3,048m)	2,300ft/min	701m/min
at 20,000ft (6,096m)	1,700ft/min	518m/min
at 30,000ft (9,144m)	1,100ft/min	335m/min
at 40,000ft (12,192m)	330ft/min	101m/min
Service ceiling	42,500ft	12,954m
with two engines	15,000ft	4,572m
Range with still-air cruising		
at 440 knots (815km/h)	3,350nm	6,208km

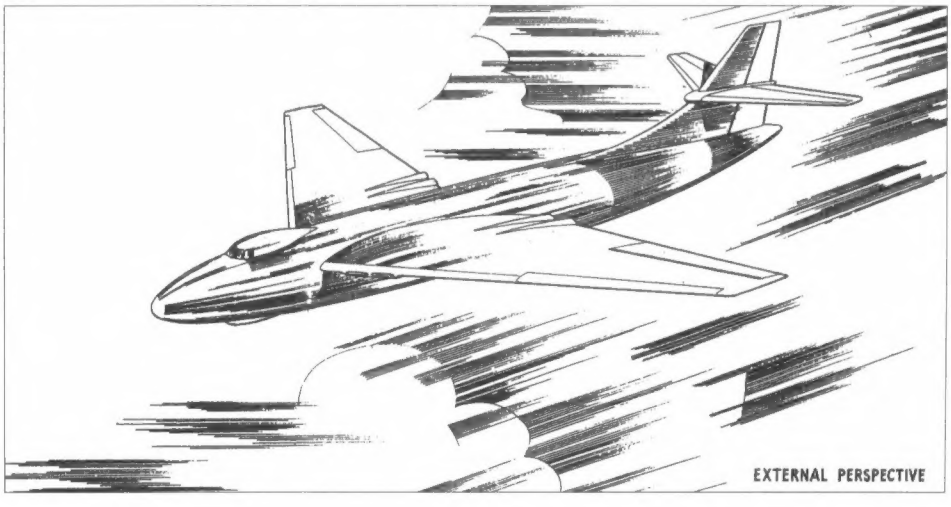
Four 7,500 lb [33.3kN] Armstrong Siddeley Sapphires

Dimensions	As for Avon	
Weights		
Tare	55,990 lb	25,397kg
Basic operational	58,910 lb	26,722kg
Bomb load	10,000 lb	4,536kg
Fuel 5,587gals (25,404 litres)	45,260 lb	20,530kg
Take-off weight	114,500 lb	51,937kg
Performance		
Max speed		
at 30,000ft (9,144m)	525 knots	973km/h
at 40,000ft (12,192m)	514 knots	952km/h
at 50,500ft (14,478m)	490 knots	908km/h
Rate of climb		
at sea level	4,600ft/min	1,402m/min
at 10,000ft (3,048m)	3,700ft/min	1,128m/min
at 30,000ft (9,144m)	1,850ft/min	564m/min
at 40,000ft (12,192m)	850ft/min	259m/min
Service ceiling	46,500ft	14,173m
with two engines stopped	21,000ft	6,401m
Range with still-air cruising		
at 465 knots (862km/h)	3,350nm	6,208km









Vickers' revised B.35/46 layout showing the new wing planform which was eventually built into the prototype.

Another design considered for B.35/46 had a swept wing with a straight leading edge, leading-edge slats, a bicycle undercarriage with twin main wheels, a tail wheel retracting into the fuselage and two small outrigger wheels retracting into the mainplane; again this had the bomb aimer's small window beneath the fuselage.

The Vickers jettisonable cabin which was felt to be too complicated.

An artist's perspective of Vickers' revised B.35/46 layout.

In about August 1948, shortly after B.9/48 was issued, Vickers (and Shorts) had to inform the Air Ministry that they were 'experiencing great difficulty in providing a jettisonable cabin as an escape facility'. The Air Ministry did not want the aircraft cancelled, so it agreed that while the fitting was still a requirement, it would be waived provided other satisfactory escape measures were installed. At the Advisory Design Conference the forecast dates for completion of the first two prototypes were given as January and July 1952 respectively.

In August 1948 George Edwards (later Sir George) brought together his company's medium bomber work in two brochures, 88008 and 88009, the former covering a Rolls-Royce Avon or basic Armstrong Siddeley Sapphire engined version whilst 88009 had four Sapphires of 7,500 lb (33.3kN) thrust and underwing drop tanks. The circulation list for these documents included a Major Siltanan of the United States Air Force based in London – the Americans had a copy of ALL British secrets at this time, even though they had denied the British the secrets of the atomic bomb and several other advanced developments.

Various ways of carrying extra fuel were investigated but the principal solutions were to fit additional fuel tanks in the fuselage and/or bomb bay, carry drop tanks on the wing tips or fit drop tanks at about mid-span. What was wanted was an absolute minimum of effort to change from short range to long range but the first option was discarded because this increased wing weight while the built-in weight of the fuselage tanks became excessive. Tip tanks were rejected because they 'over relieved' the wing while the take-off bending moments would have required excessive strengthening of the wing, which again involving an unacceptable weight penalty for what was medium-range aeroplane.

Mid-span tanks were accepted as the solution but they incurred a weight penalty of about 450 lb (204kg) due to the need to strengthen the wing outboard of the drop tanks, make provision for drop tank fittings and strengthen the inner wing in the region of the chassis attachments. The B.9/48 range requirement was 3,350nm (6,208km) based on a 1,500nm (2,780km) radius of action and this needed 5,350gals (24,326 lit) of fuel; the long-range requirement was 4,350nm (8,061km) based on a 2,000nm radius (3,706km) with the external tanks being dropped when empty. The Air Ministry considered that the stated 350nm (649km) fuel reserve was insufficient and so increased the required range to 4,600nm (8,524km) with fuel tanks jettisoned or 4,350nm with the tanks still onboard, the amount of fuel required being 8,350gals (37,967 lit) while the size of the tanks needed to carry the extra volume would have to be 1,500gals (6,820 lit) each.

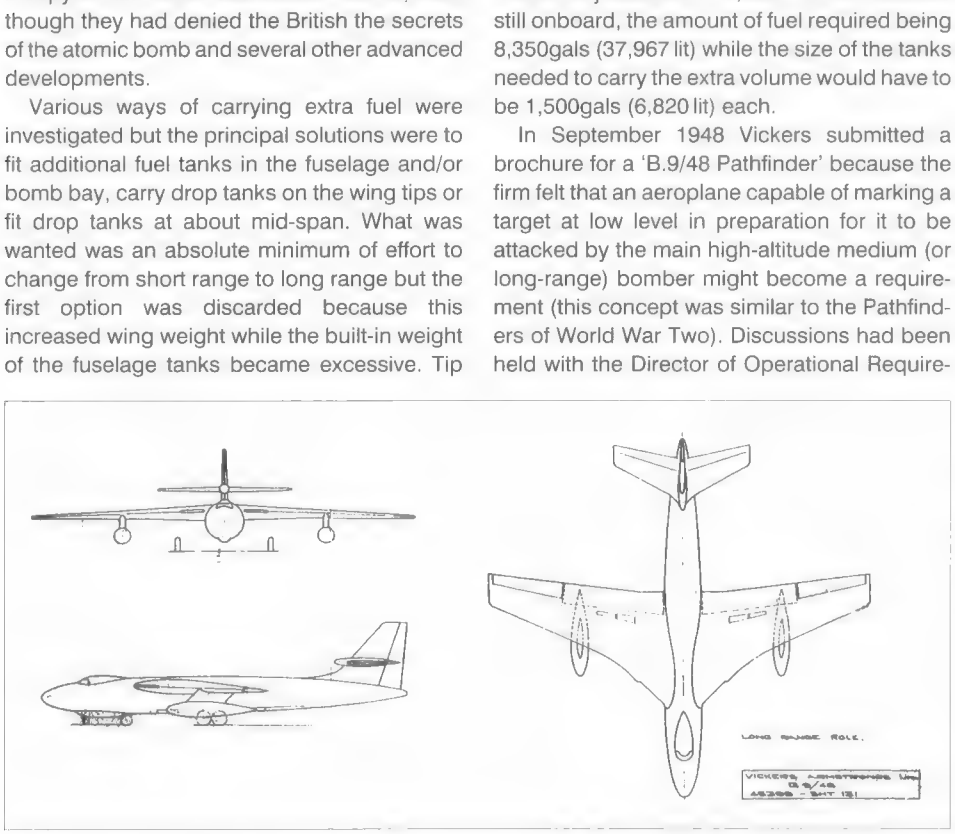
In September 1948 Vickers submitted a brochure for a 'B.9/48 Pathfinder' because the firm felt that an aeroplane capable of marking a target at low level in preparation for it to be attacked by the main high-altitude medium (or long-range) bomber might become a requirement (this concept was similar to the Pathfinders of World War Two). Discussions had been held with the Director of Operational Requirements (DOR), the Central Bomber Establishment and the Ministry of Supply and this brochure was the result. There were three versions – one fitted with four Avons for medium range, a second with four Sapphires to cover a 3,350nm range and the third again with four Sapphires but offering a 4,600nm range.

The aircraft was fitted with dive brakes (as per the standard B.9/48) which would allow a dive of 350 knots (649km/h) EAS to be held at a constant 15°. The change from high to low altitude mainly required structural reinforcing to cater for the increased low-level speed but also, in place of the normal B.9/48 bomb load, provision was provided for two 1,000 lb (454kg) Target Indicators. The additional fuel for each version would be carried in special bomb bay tanks and it was felt that these pathfinders could be worked into the production line without difficulty. The submission was considered by the Air Staff but, at this time, there was no clear policy on the future use of the B.9/48. Another study was instigated in March 1949 to determine a possible Target Marker cum Photographic Reconnaissance (PR) version of the aircraft.

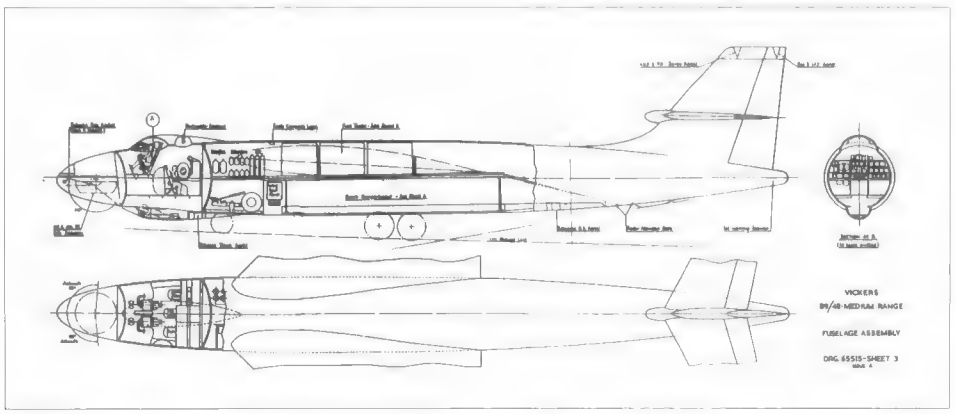
Returning to the prototypes, preliminary design work continued at Weybridge through 1948 and in October the Air Ministry awarded Vickers its contract for two prototypes under No 6/Aircraft/2399. Financial sanction was authorised in December 1948, the order was placed on 2nd February 1949 and the two machines were allocated serial numbers WB610 and WB615. At an Engine Installation Advisory Design Conference it was stated that the B.9/48s would be suitable for either Avon or Sapphire engines since both gave a thrust of 7,500 lb (33.3kN; developments of the Avon were by now expected to provide the same thrust as the Sapphire).

In May 1949 the Air Staff visited Weybridge to inspect a mock-up of the escape facilities that Vickers had prepared to replace the jettisonable cabin. However, the arrangements were felt to be inadequate and Vickers was requested to provide ejection seats for the two pilots; the Air Staff was prepared to accept the planned escape door for the remaining crew members. In September the complete B.9/48 mock-up was passed for production.

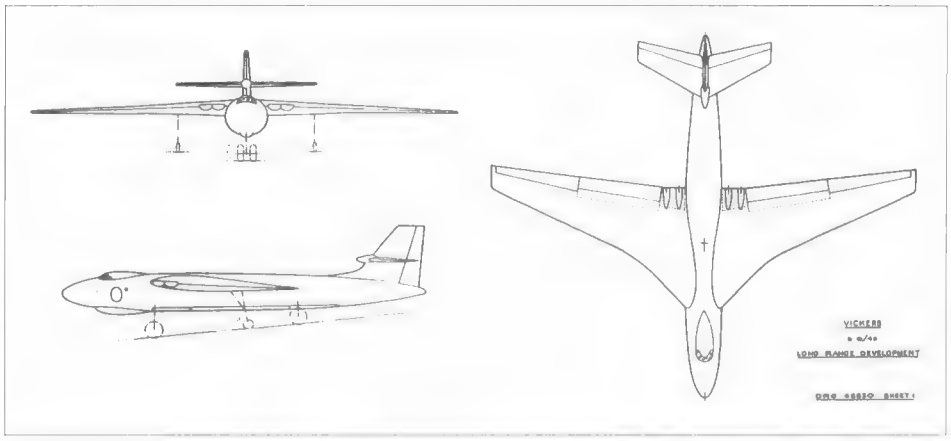
A very important decision also taken in September covered the need for a high-altitude aircraft to test the new instruments, armament, radar, navigation equipment, etc required by all these new medium bombers. Vickers, and initially the MoS, wanted a third prototype to complete this work but eventually it was decided that using the Short Sperrin prototypes would be cheaper and there was no need for another.



The version of the Vickers medium bomber fitted with long-range tanks as per brochure 88009.



Drawing showing detail of the fuselage assembly with the five crew and the bomb-aiming positions (December 1948, Drawing 65515 Sheet 3).



Right: **The B.9/48 Mk.II of August 1949 had a larger span and bicycle undercarriage but otherwise shared the same configuration as the prototype Valiants.**

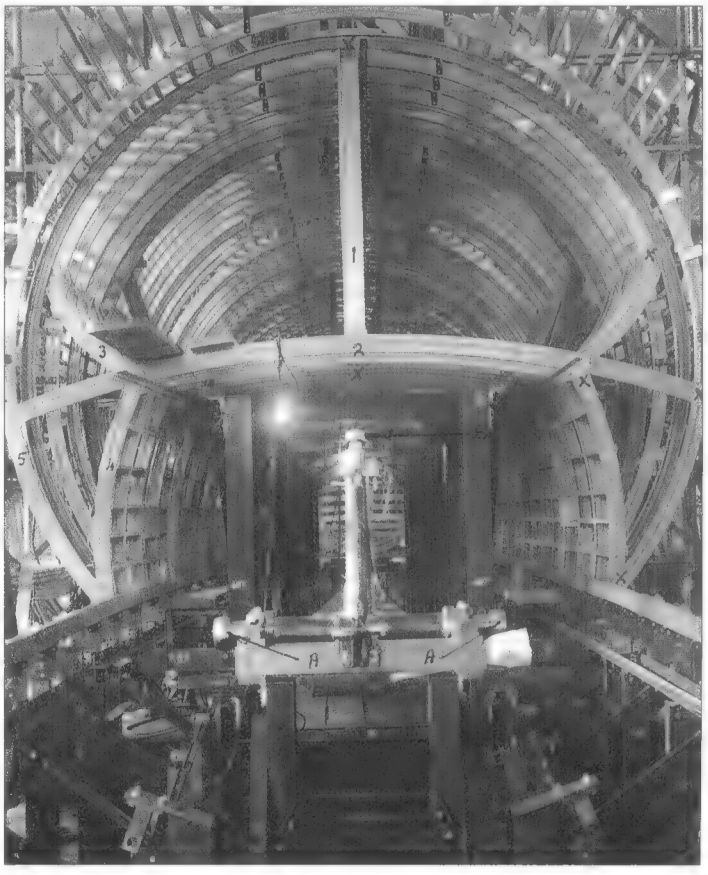
Bottom left: **The prototype's starboard outer wing leading edge under construction in the jig prior to the fitment of de-icing ducting and inner plating. The large holes at the bottom were for circulating hot air to the leading-edge nose.**

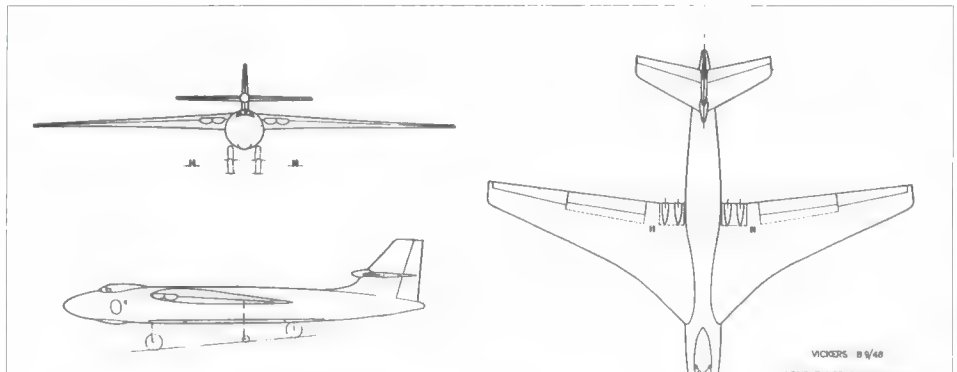
Bottom right: **Cross-section of the prototype's main fuselage and nose wheel jig. For the construction of the prototype's fuselage the items marked 1 to 5 were located and positioned from pre-drilled holes and built piecemeal in the building jig. On production aeroplanes, however, items 1 to 4 were treated as sectional sub-assemblies.**

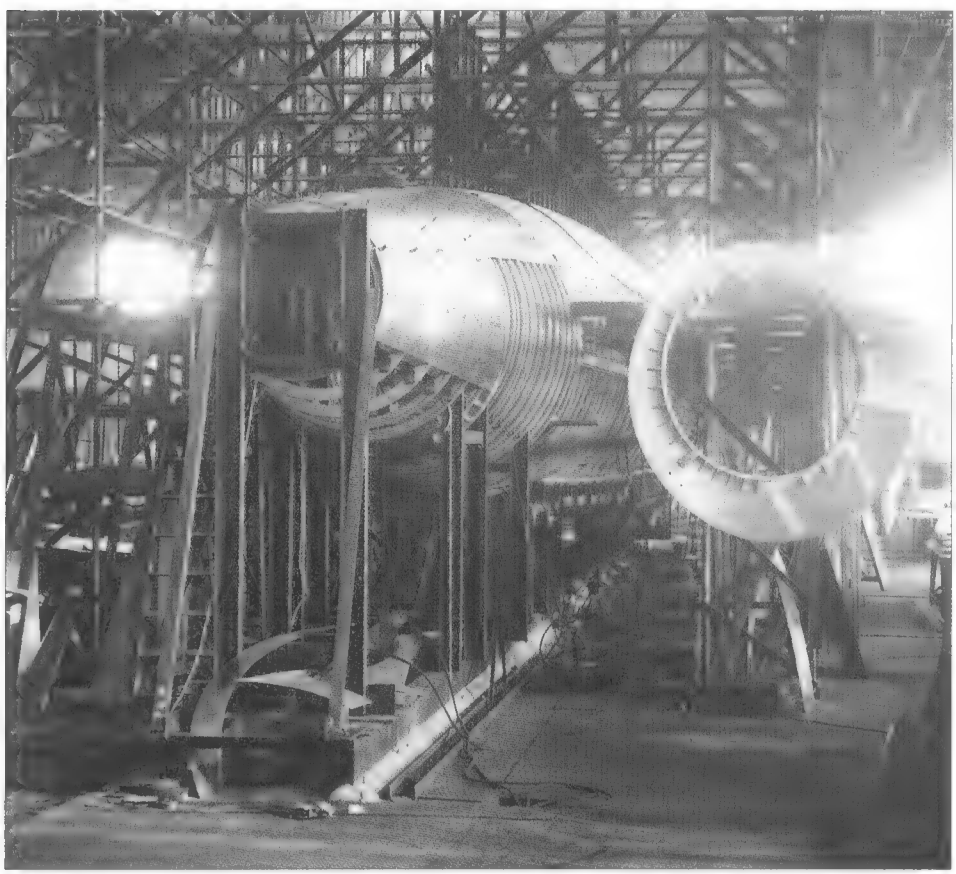
B.9/48. During November Vickers looked closely at two methods of increasing the B.9/48's flexibility. Underwing drop tanks were considered that would push up the range from 3,350nm to 5,000nm (6,208km to 9,265km) and external bomb cocoons were also a possibility to increase the bomb load over short ranges (these were similar to a type used on the pre-war Wellesley).

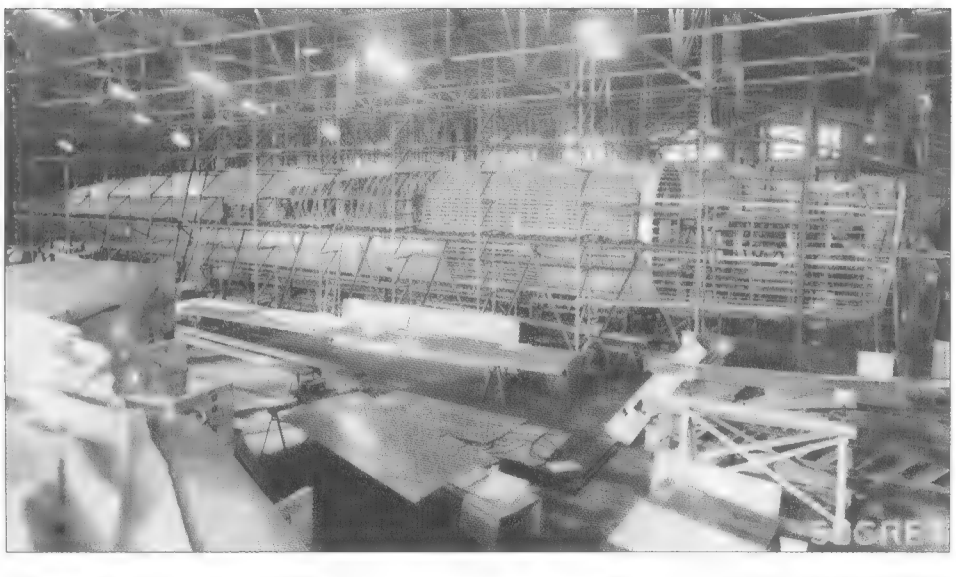
A major development of the B.9/48 called the Mk.II was prepared for the Air Ministry in August 1949. This was basically identical to the medium-range original but with the following changes:

1. Extended wing tips increased the span by 14ft (4.27m) to 127ft 3in (3.88m); this increased the aspect ratio from 5.45 to 6.58 and the wing area from 2,354ft² (218.9m²) to 2,464ft² (229.2m²).
2. The wing was thinned at the crank from 11% to 10% and the new tip from 9% to 8% while the sweepback on the inner wing would be 37° and on the outer portions 21°. (The aerodynamic development time for this new version was expected to be small but previously, in spring 1948, a 'thin wing' variant of 11% inboard and 9% outboard had been rejected by the Air Staff because it would need a longer take-off run and a bicycle undercarriage and would also present serious practical difficulties in accommodating suitable powerplants in the thin wing.)
3. A bicycle-type undercarriage would be mounted in the forward fuselage and aft of the bomb bay with light stabilisers outboard of the engines. This arrangement had been suggested before (see drawing on page 9) and was being used in the USA. It left space in the wings for the extra fuel while the cut-out in the wing structure required for the original chassis would no longer be required, giving an appreciable saving in structure weight. Vickers recommended that an aircraft like the Valetta should be converted to try out such an undercarriage. The bomb bay would be 5ft (1.52m) shorter but could still take the 10,000 lb (4,536kg) and 5,000 lb (2,268kg) bombs exactly as the standard B.9/48; however, the 15 1,000 lb (454kg) load would have to be cut to ten only.
4. The engines would be switched to four 9,700 lb (43.1kN) Rolls-Royce RB.80/1, or Rolls R.A.4 Tynes each producing 8,300 lb (36.9kN), for an even longer range. This would entail some structural alteration to the inner wing but the existing spars and ribs would be retained together with the existing wing tanks which, with additional wing tanks, would give a total fuel load of 8,250gals (37,512 lit). The RB.80/1s would give a range of 5,600nm (10,377km) at an all-up-weight of 148,000 lb (67,133kg); over the target the aircraft would fly at 472 knots (875km/h) and 48,200ft (14,691m).









The estimated performance figures with the RB.80/1 at 108,300 lb (49,125kg) weight were:

Top speed		
at 30,000ft (9,144m)	509 knots	943km/h
at 40,000ft (12,192m)	496 knots	919km/h
at 50,000ft (15,240m)	480 knots	889km/h
Rate of climb		
at sea level	4,050ft/min	1,234m/min
at 20,000ft (6,096m)	2,950ft/min	899m/min
at 40,000ft (12,192m)	1,200ft/min	366m/min
Service ceiling	48,600ft	14,813m
with two engines	18,000ft	5,486m
Range with 10,000 lb bomb		
at 472 knots (875km/h)	5,600nm	10,377km

With Tynes at 105,850 lb (48,014kg) the figures became:

Top speed		
at 30,000ft (9,144m)	507 knots	939km/h
at 40,000ft (12,192m)	493 knots	914km/h
at 50,000ft (15,240m)	474 knots	878km/h
Rate of climb		
at sea level	3,880ft/min	1,183m/min
at 20,000ft (6,096m)	2,550ft/min	777m/min
at 40,000ft (12,192m)	780ft/min	238m/min
Service ceiling	46,000ft	14,021m
with two engines	16,000ft	4,877m
Range with 10,000 lb bomb		
at 472 knots (875km/h)	4,772nm	8,843km

In January 1950 Vickers produced a Pathfinder version of the B/9/48 Mk.II (brochure 92736) with a strengthened structure to cater for diving speeds of up to 580 knots (1,075km/h) EAS. Fuel tankage was increased to 9,400gals (42,7412 lit, all stowed internally) to give a range of 5,600nm (10,377km) plus a 20-minute search near the ground at 350 knots (649km/h). This version would have 9,700lb (43.1kN) Rolls-Royce RB.80 Conways and weigh fully loaded 158,500 lb (71,896kg) compared to the above high-altitude Mk.II's 148,000 lb (67,133kg). Span was 127ft 9in (38.9m), length 107ft 6in (32.8m), height 26ft 6in (8.1m), wing area 2,464ft² (229.2m²); still-air range was 5,602nm (10,381km) at 472 knots (875km/h). In the bomber role the aircraft would weigh 163,000 lb (73,937kg) fully loaded. Fitted with Tynes it would have a range of 4,900nm (9,080km) and have a loaded weight of 155,000 lb (70,308kg) as a pathfinder and 160,500 lb (72,803kg) as a bomber. The design also featured a four-wheel main undercarriage which, because it was mounted so close to the fuselage, still needed a pair of outriggers.

Top: **The B.9/48 Mk.II development drawn in November 1949 with unusual four-wheel main gears plus outriggers**

Centre: **The rear fuselage in its building jig, seen just after plating had commenced.**

Bottom: **The prototype Valiant WB210 under construction in Vickers' secure hangars at Foxwarren, just down the road from Weybridge. Plating is under way and the front pressure cabin bulkhead is just visible in the top right hand corner.**

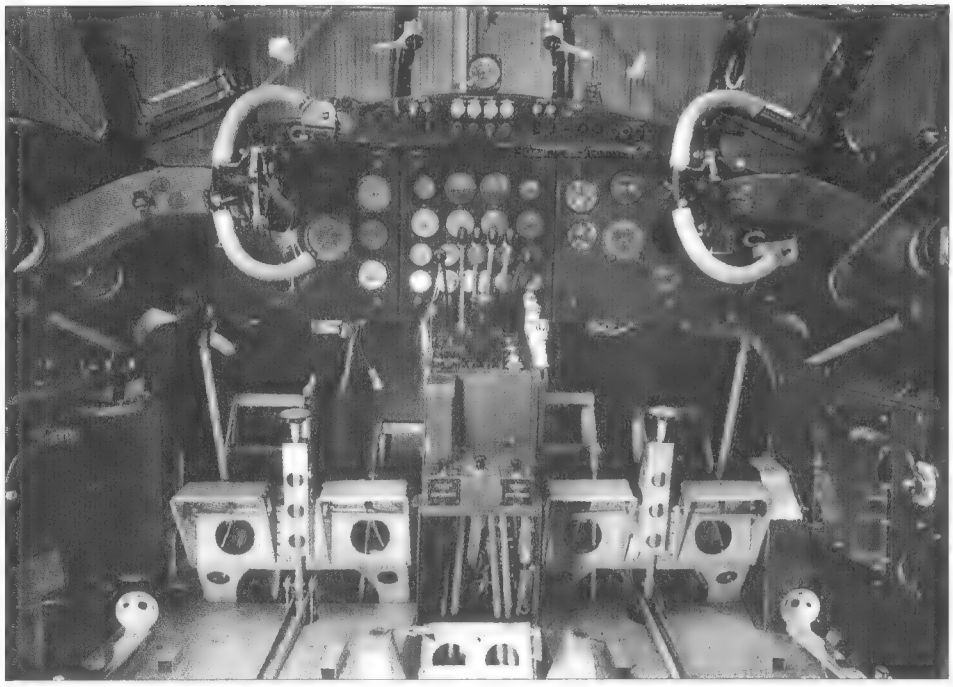
Modern technology usually needs to be updated fairly quickly and, of course, that means that if weight is added then the aircraft's centre of gravity and performance is altered and has to be corrected or compensated for. In February 1950 the Air Ministry asked if the heavy Green Satin navigation aid could be installed into the B.9/48 and if the aircraft was capable of carrying Blue Boar, a television-guided bomb also currently being developed and built by Vickers. Both would affect the aircraft's balance and performance.

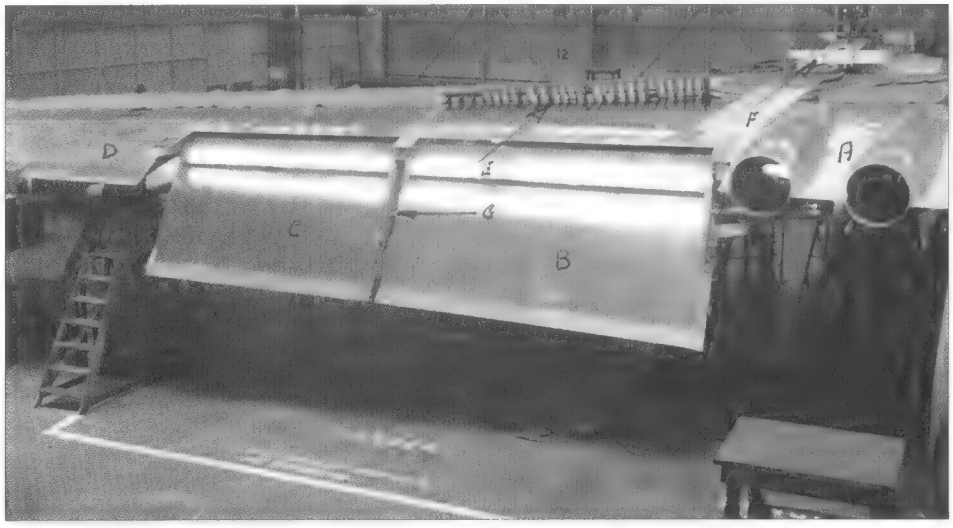
During the same month a meeting between Vickers and the Air Ministry discussed the policy towards the future PR and Target Marker aircraft. At last Operational Requirements were raised to cover them, OR.279 for the PR version and OR.285 for the Target Marker to locate and mark a precise target from low or high altitude. The latter was issued in July 1950 but OR.279 was delayed until October 1951 because attempts were made to combine both requirements into one package, which eventually proved to be impossible.

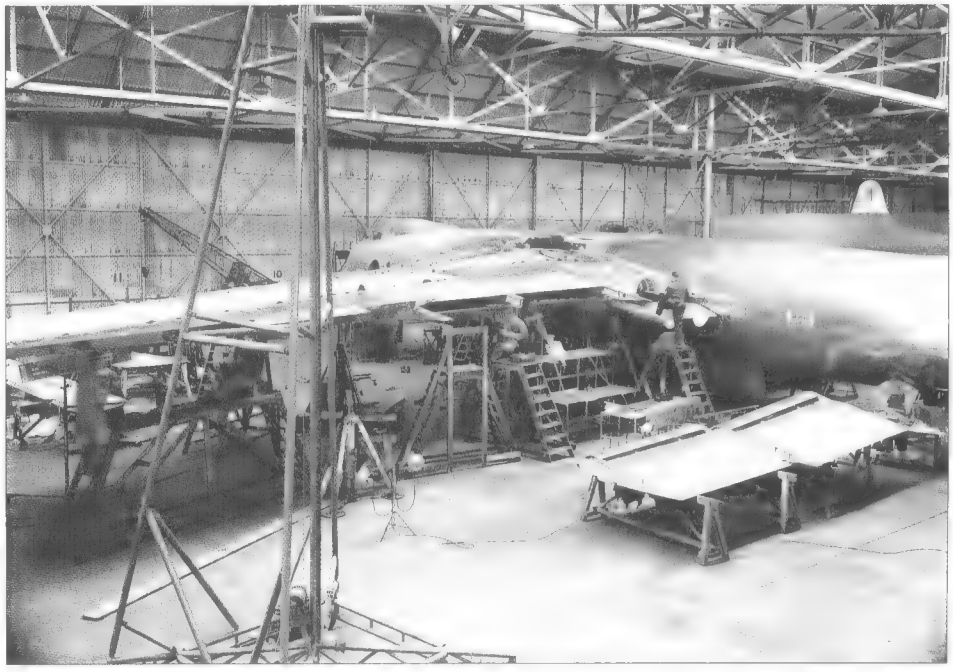
In the meantime Vickers was studying alternative ways of fitting defensive armament to the B.9/48 to counter the possibility of supersonic enemy fighters being available by 1957; in March 1950 it completed preliminary investigations for two different approaches:

1. **Tail barbette**

   This consisted of a periscopic sight mounted in the after end of the pressure cabin with servo equipment and a convergence computer placed immediately to the rear but outside the cabin. A barbette with two 20mm Hispano cannon on a gymbal-type mounting was situated in the rear of the fuselage with adjacent ammunition boxes holding 700 rounds per cannon, and a radar scanner was placed in the rear end of a special 'hour glass' fairing at the juncture of the fin and tail plane. However, the Blue Boar indicator and control units in the cockpit would have to be moved from their present position and major alterations to the existing layout of the radio and navigator's stations would be needed. These steps might also need an increase in cabin length of some 18in (45.7cm) to fit everything in, while the complete installation would add 2,040 lb (925kg) of weight; this, with a corresponding reduction of fuel, would cut range by 240nm (445km).







Top: **First and second pilots' instrument panel, not yet complete. Note the side mounting of the 'stick', no longer between the pilot's legs.**

Centre: **General view of the port wing trailing edge with the ailerons, flaps and dive brakes attached before the main plane is completed.**

A. No 1 Flap in 'up' position
B. No 2 Flap in 'down' position
C. No 3 Flap, interconnected with No 2 and G
D. Inboard half of the aileron
E. Upper dive brakes in extended position
F. Engine hoist – ground equipment
G. Coupling between Nos 2 and 3 flaps

Right: **A Valiant prototype under construction at Foxwarren with much of the skinning in place; it is uncertain which this is – WB210 or WB215.**

2. **Towed missiles**

An alternative was the possibility of towed missiles. The general installation was somewhat similar to that for the guns with the exception that the weapons themselves were replaced by three missiles fitted with proximity fuses and having the following characteristics:

all-up-weight 150 lb (68kg) comprising a 50 lb (22.7kg) warhead, 50 lb of control gear and 50 lb of structure, span 5ft 6in (1.68m), wing area 4ft² (0.37m²) and body diameter 7in (17.8cm).

These missiles would be mounted on launch rails at the rear of the B.9/48 and would be towed behind the aircraft on 3,000ft (914m) of 20g wire attached to individual winches; once 'launched' they could be controlled using the wire across a 30° cone but they could not be recovered. This idea would incur a weight penalty of 1,415 lb (642kg) and, to maintain the present take-off weight, this would mean a reduction in fuel which would decrease the range by 170nm (315km). Needless to say, neither of these schemes was pursued further; from now on the emphasis was placed on buying a system from America.

Another Vickers proposal of April 1950 covered a B.9/48 Long-Range Development in both bomber and pathfinder versions (brochure 93865). This was fitted with four Rolls-Royce Conway engines and offered a range of 5,000nm (9,265km), the standard bomber's internal tanks being supplemented by an external drop tank under each wing to give a total tankage of 9,050gals (41,150 lit) at an all-up-weight of 144,500 lb (65,545kg). Each drop tank contained 1,650gals (7,502 lit), six fuselage tanks totaled 3,710gals (16,869 lit) and five wing tanks added another 2,040gals (9,276 lit). The Pathfinder B.9/48 was now much changed; in particular the undercarriage had been moved from the wing into speed pods with four-wheel bogeys retracting straight back and up into these pods. This left the wing empty and ready to receive more fuel tanks, a total of eight per side giving a total capacity of 2,190gals (9,958 lit) in each wing. The pathfinder's fuel capacity amounted to 8,090gals (36,784 lit) plus another optional 670gals (3,046 lit), or 1,630gals (7,411 lit), in the bomb bay for an overall figure of 8,760 or 9,720gals (39,831 or 44,196 lit).

As part of this long-range Pathfinder study, Vickers proposed another form of rear armament using the speed pod in which they were planning to put the wing-mounted undercarriage (a similar form was used on the Mk.II Valiant covered in Chapter 3). A single 20mm Hispano cannon would be placed in the rear of each pod to be remotely controlled from the cockpit; there would be space for 700 rounds per gun and each weapon would be able to traverse from +11° to -30° in depression and 15° each way in azimuth. This arrangement would have been somewhat similar to an earlier experimental fit in a Vickers Warwick which itself had been used as a testbed for the Vickers Windsor four piston engined bomber.

In June 1950 Vickers completed proposals for a B.9/48 Photographic Reconnaissance version (brochure 94664) which suggested one variant for use in day operations and another at night. The day model utilised the bomb bay solely to carry a battery of eight F.96 cameras with 46in (117cm) lenses, which were housed in two quickly detachable crates, plus a further single basic cover camera. The night model had 21 650 lb (295kg) photo flashes housed in the bomb bay on Vickers multiple 1,000 lb (454kg) bomb carriers; two FX.89 cameras with 36in (91cm) lenses were the only cameras carried and these were relegated to the rear end of the aircraft, just forward of the tail.

At this stage there was still talk about using either Conways or 'developed' Avon engines in the bomber and pathfinder versions (the target marker/pathfinder eventually became the Valiant B Mk.2 and its story is continued in Chapter 3). Some of the estimated data was listed, as shown in the table on this page.

Medium-Range PR Aircraft	CONWAY				AVON DEVELOPMENT			
	Bomber		Pathfinder		Bomber		Pathfinder	
Day Role								
Take-off weight, lb (kg)	105,300	(47,764)	118,000	(53,525)	105,610	(47,905)	117,800	(53,434)
Speed over target, knots (km/h)	472	(875)	471	(874)	450	(834)	450	(834)
at height, ft (m)	50,000	(15,200)	48,200	(14,700)	48,500	(14,800)	46,300	(14,100)
Range, nm (km)	3,350	(6,028)	3,350	(6,028)	3,350	(6,028)	3,350	(6,028)
Night Role								
Take-off weight, lb (kg)	123,500	(56,020)	135,750	(61,576)	122,950	(55,770)	136,550	(61,939)
Speed over target, knots (km/h)	472	(875)	471	(873)	450	(834)	450	(834)
at height, ft (m)	47,000	(14,300)	45,400	(13,800)	45,000	(13,700)	43,200	(13,200)
Range, nm (km)	3,350	(6,028)	3,350	(6,028)	3,350	(6,028)	3,350	(6,028)

Long-Range PR Aircraft	CONWAY				AVON DEVELOPMENT			
	Bomber		Pathfinder		Bomber		Pathfinder	
Day Role								
Take off weight, lb (kg)	144,100	(65,364)	150,000	(68,040)	139,900	(63,459)	147,100	(66,725)
Range, nm (km)	5,800	(10,747)	5,300	(9,821)	5,430	(10,062)	5,000	(9,265)
Night Role								
Take-off weight, lb (kg)	50,000	(68,040)	50,000	(68,040)	50,000	(68,040)	50,000	(68,040)
Range, nm (km)	5,000	(9,265)	4,200	(7,783)	4,700	(8,709)	4,100	(7,597)

Back in January 1949 it had been proposed to install Avon engines in the first prototype and Sapphires in the second. In June 1950 the prototype contract was amended to confirm that the first machine would have Avons (in fact Avon R.A.3s were fitted), the second initially Sapphires but later possibly Rolls-Royce Conways or Bristol Olympus (the Conway R.Co.2 of 9,250 lb [41.1kN] thrust would give only a slight change in performance and weight). In September the MoS agreed that the first prototype's original R.A.3 engines should, later on, be replaced by a substantially redesigned version known as the R.A.14 (which had earlier been known as the R.A.3/1 and R.A.8).

Left: **A Rolls-Royce Avon R.A.3 engine ready to be installed in WB210's port inner position.**

Photograph on the opposite page:

Lovely view of WB210 flying over Totland, Isle of Wight, on its first flight, showing its beautiful streamlined shape in natural metal finish with just RAF roundels for colour. Phil Butler collection

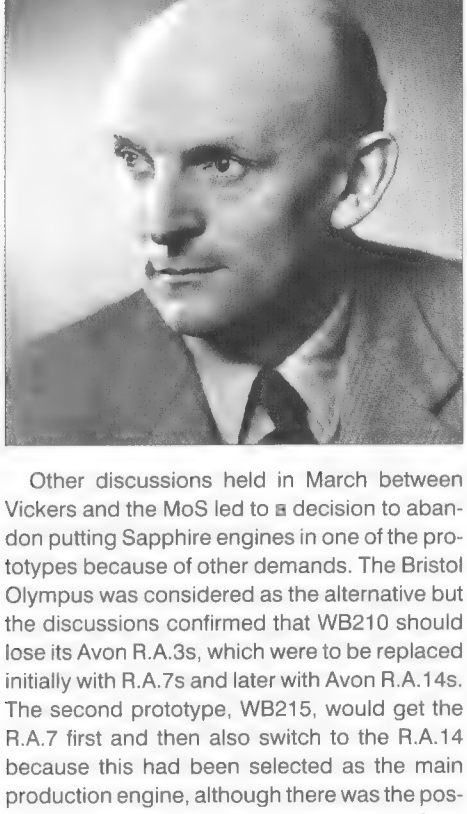
Into the Air
Prototypes and B Mk.1

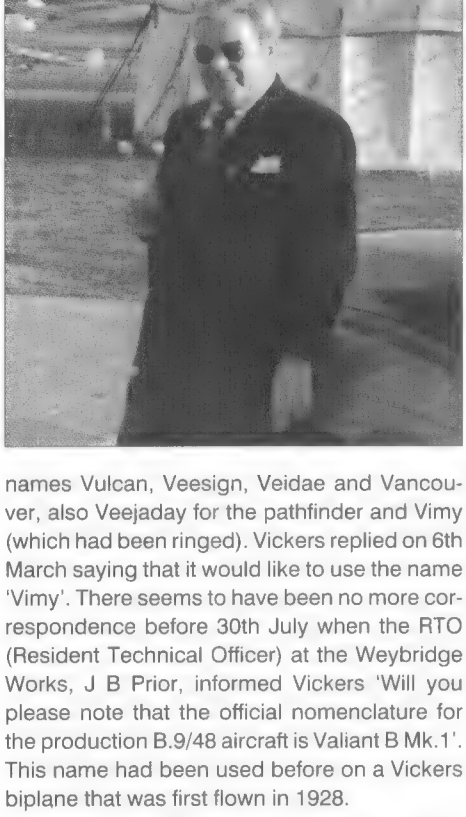
In October 1950 the Director of Military Aircraft Research and Development at the MoS advised the Director of Operational Requirements at the Air Ministry that if the RAF was to be reasonably certain of having a modern bomber in three years' time, there was no choice but to place a production order at once instead of waiting until flight experience had been gained with the prototype. More delays and this would push the project even further into the future. As a result Vickers sought Air Ministry approval in December for the placing of a production contract for at least 25 aircraft. The Air Ministry was quick to respond and approval was given on 8th January 1951 for the production of 25 aeroplanes with the actual contract being awarded on 9th February at an estimated cost of £8m. Their serials were to be WP199 through WP223 under contract No 6/Air/6313/CB6(c). In-house the prototype B.9/48 was known as the Vickers Type 660; pre-production aeroplanes WP199 to WP203 became the Type 674 and production from WP204 onwards the Type 706.

By October 1950 the manufacturer had become very optimistic because work on the aircraft had progressed exceedingly well with no major hold-ups or snags. Such was its confidence that Vickers told the Air Ministry that WB210, the first prototype, would fly in June 1951 and not January 1952 as had previously been forecast. WB210 was built in the Foxwarren experimental shop which was a Vickers dispersal site close to Brooklands. The Air Ministry stuck to the original estimate and was suitably surprised when WB210 was transported from Foxwarren by land and flown from the grass airfield at Wisley on 18th May 1951 (this achievement meant that the Vickers B.9/48 Interim Bomber had beaten the Shorts S.A.4 Sperrin Interim Bomber into the air by 12 weeks). It was crewed by 'Mutt' Summers and G R 'Jock' Bryce and the flight was kept at low level with the undercarriage down.

The Vickers staff who were the most responsible for the design and construction of the Valiant were Sir Hew Kilner (Managing Director Vickers-Armstrongs Ltd), George R Edwards (Chief Designer), B Stephenson (Designer Structures), H H Gardner (Designer Stress), E J Richards (Designer Aerodynamics), A E Houghton (Experimental Manager at Foxwarren), T Gammon (Works Manager), T Parker (Works Superintendent), L R Webb (layout, jig and tool design), J E Pull (planning and subcontract), Captain J 'Mutt' Summers (Chief Test Pilot), G R 'Jock' Bryce (Valiant Co-pilot), H Hemsley (Deputy Chief Designer), E E Marshall (Assistant Chief Designer) and E Allwright (Assistant Chief Designer). Particularly notable contributions came from the three assistant chief designers Henry Gardner, Elfyn Richards and Basil Stephenson. After the death of Sir Hew Kilner in 1953, George Edwards was made Managing Director of Vickers-Armstrongs (Aircraft) Ltd; he was later knighted.

Three more trips were made from Wisley before WB210 was flown to Hurn on 1st June to continue its flight programme; at the time Wisley was being brought up to date with a paved runway to allow modern jet aircraft to operate from there more easily. Earlier, on 21st March 1951, the recommendations of a Working Party on tail armament had been considered and it was decided that a single 30mm Aden gun should be fitted in the tail of all future bombers. This should be adopted as a matter of importance and the case for installing it in the B.9/48 should be gone into thoroughly. The MoS was informed and asked to undertake a full feasibility study.





Far left: **Portrait of George (later Sir) Edwards.**

Left: **Portrait of 'Mutt' Summers.**

Bottom: **A distinct feature of WB210 was its straight intakes.**

Photographs on the opposite page:

Nose view of WB210.

WB210 seen on the ground in May 1951 with flaps down.

Rear view of WB210 showing the huge expanse of flap and the aircraft's massive tail.

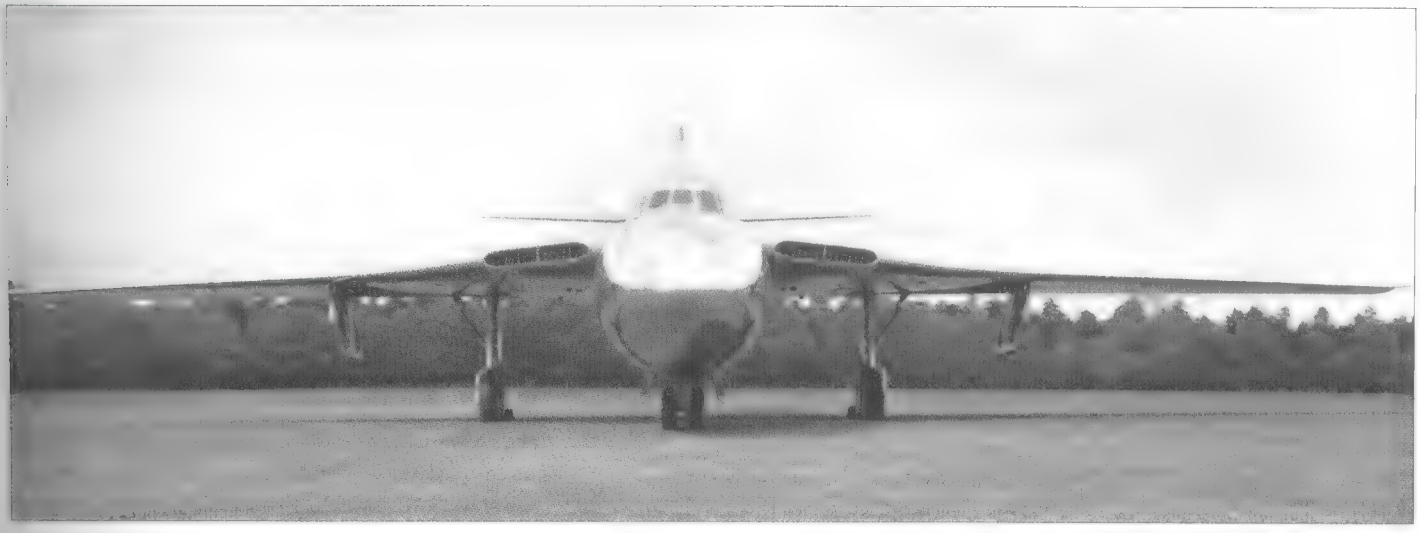
The Valiant's flap arrangement is shown to even better effect in this shot of WB210 taken at its home aerodrome of Wisley. A Vickers Valetta can be seen to the left.

Other discussions held in March between Vickers and the MoS led to a decision to abandon putting Sapphire engines in one of the prototypes because of other demands. The Bristol Olympus was considered as the alternative but the discussions confirmed that WB210 should lose its Avon R.A.3s, which were to be replaced initially with R.A.7s and later with Avon R.A.14s. The second prototype, WB215, would get the R.A.7 first and then also switch to the R.A.14 because this had been selected as the main production engine, although there was the possibility of replacing it with the Olympus or Conway later. The Valiant B Mk.2 (Chapter 3) would have the R.A.14 from the start.

On 19th February 1951 V E Bass of the MoS wrote 'An official designation is required for the B.9/48 aircraft. Names of bomber aircraft should be selected from the category of place names – an inland town of the British Commonwealth or associated with British history'. However, scribbled on his letter were the names Vulcan, Veesign, Veidae and Vancouver, also Veejaday for the pathfinder and Vimy (which had been ringed). Vickers replied on 6th March saying that it would like to use the name 'Vimy'. There seems to have been no more correspondence before 30th July when the RTO (Resident Technical Officer) at the Weybridge Works, J B Prior, informed Vickers 'Will you please note that the official nomenclature for the production B.9/48 aircraft is Valiant B Mk.1'. This name had been used before on a Vickers biplane that was first flown in 1928.

In June 1951 Vickers requested approval from the Air Ministry for an order for 24 additional production Valiant B Mk.1s (including five for MoS development flying) and 17 B Mk.2 aircraft (including one for the MoS). The Ministry then applied to the Treasury for funds for this order and it was approved in September, a contract being placed in October which brought the total of Valiants on order to 66.

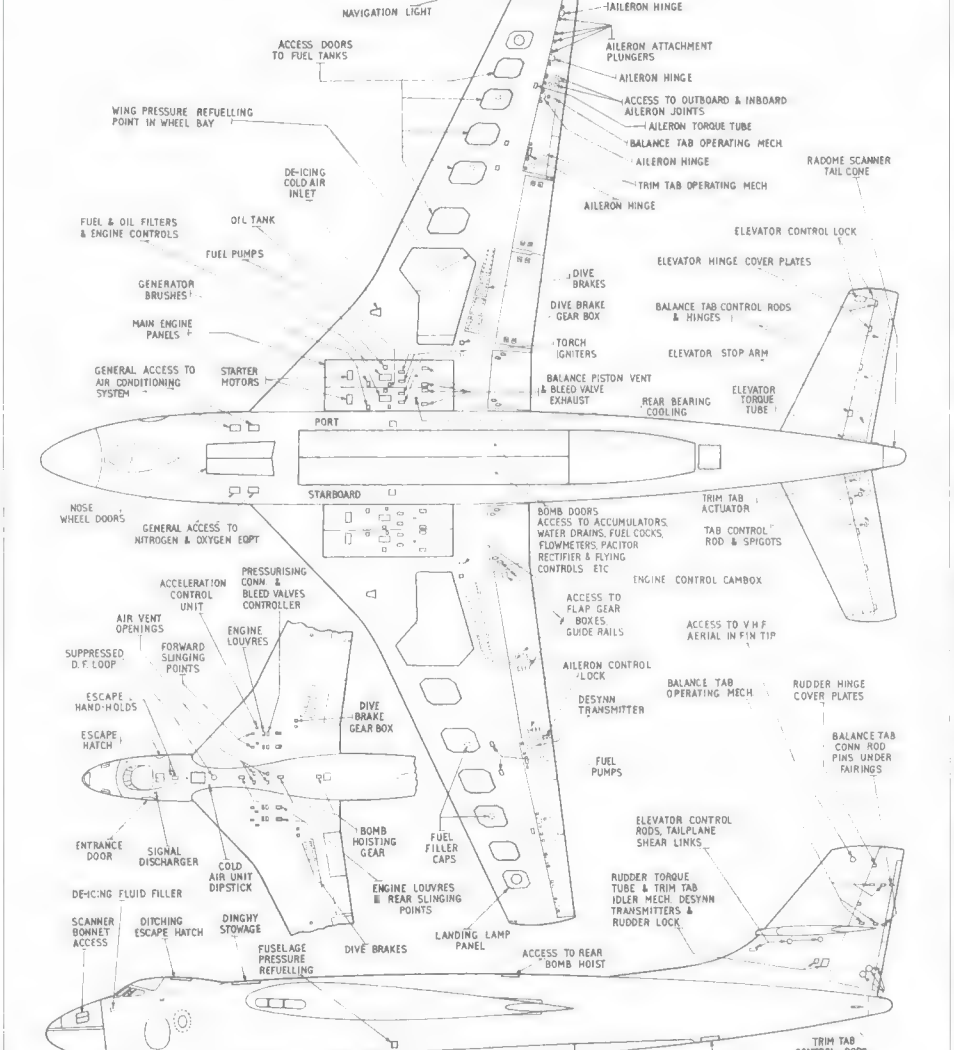
The Ministry, however, became concerned about increases in the Valiant's weight and its inability to take off from runways under 1,600yds (1,483m) long in the overload condition or in a tropical environment; in the first six months of 1951, several meetings were held to discuss this problem. The last one in July suggested that an external pack containing Rocket Assisted Take-Off Gear (RATOG) should be investigated and this was passed to Vickers who also had to look at the possibility of using water methanol injection for the same purpose. As a temporary solution, the Air Ministry increased the specified take-off distance to 2,300 yards (2,103m). The specification was also amended in July 1951 to include a need for 10,000 lb (4,536kg) bombs to be carried under each wing for short-range operations. This resulted from an Air Ministry decision (made the previous October) stating that the B.9/48 should be developed to carry the bomb cocoons or alternative underwing fuel tanks described in the previous chapter.



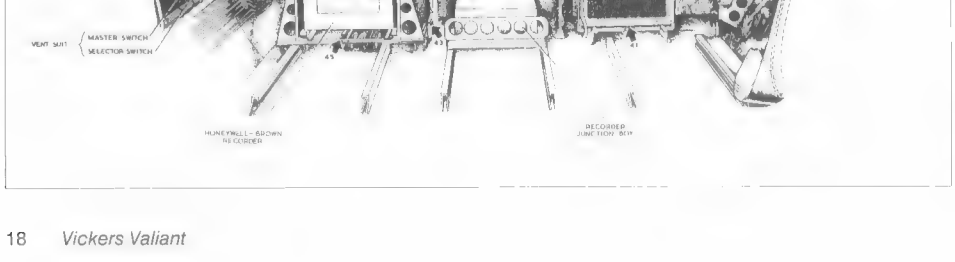
The following month the Prototype Final Conference took place to clear the Valiant for production and one subject was criticism of the extremely uncomfortable Martin-Baker ejection seats. The seat originally chosen to be installed had been designed for a fighter but at this conference it was changed from a Mk.I to a Mk.III so that the crew could try it and comment on its comfort before Vickers had to fit ejection seats in production machines. In June 1952, after some aircrew had had a chance to try the seats, it was concluded that after an hour and a half's flying it was still not comfortable enough and therefore needed to be improved.

By 1st September 1951, when it was flown to Wisley, WB210 had flown for 70 hours and achieved 300 knots (556km/h) IAS and Mach 0.85 at 43,000ft (13,106m) with slight buffeting, but the aircraft could be trimmed easily to fly hands off. Four RAF pilots from the Aircraft and Armament Experimental Establishment (A&AEE), Boscombe Down, flew it from Wisley and were favourably impressed with its overall performance. At Wisley a programme of improvements was undertaken to incorporate pressurisation equipment, the de-icing system and to make structural changes to increase wing and chassis strength for flights at 150,000 lb (68,040kg) all-up-weight for extended range and overload conditions. After this three-month grounding WB210 flew back to Hurn on 22nd December. Prior to this break, however, the new type had been revealed to the public at the September SBAC Farnborough Air Show.

Returning to the aircraft's development, in May 1951 both manufacturer and Ministry began to investigate the possibilities of flight refuelling. Also the subject of tail armament was resurrected and in October the practicability of installing the American B-36 bomber's tail defence system was discussed; once again the subject was put on hold, awaiting information from America. On a more practical note, a severe labour shortage hit Vickers in November because the firm was fully occupied building Vikings, Valettas and the Varsity while the Viscount airliner was also coming into production.



ACCESS PANELS



Top left: **Works Drawing of WB210 showing the maintenance access panels.**

Top right: **The Valiant's navigation console.**

Above: **A view of consequence to model makers is this close-up of the Valiant's production undercarriage with its tandem wheel arrangement.**

Left: **The crew station on the prototype Valiant seems crowded but as time went on and different and additional requirements and their equipment were called for, the designers managed to fit a lot more into this space.**

Photographs on the opposite page:

Top: **Works Drawing showing the powerplant installation, the short jet pipes of prototype WB210 and the method of engine removal.**

Centre: **Drawing of a tail warning system called 'Eager Beaver' with two 20mm Hispano cannon as it would have appeared if fitted in the tail of the Valiant. The tail warning scanner is housed in the pod directly above the gun turret.**

Bottom: **The remains of one of the inner mainplanes of WB210 after it had crashed into a farmer's field near east Christchurch.**

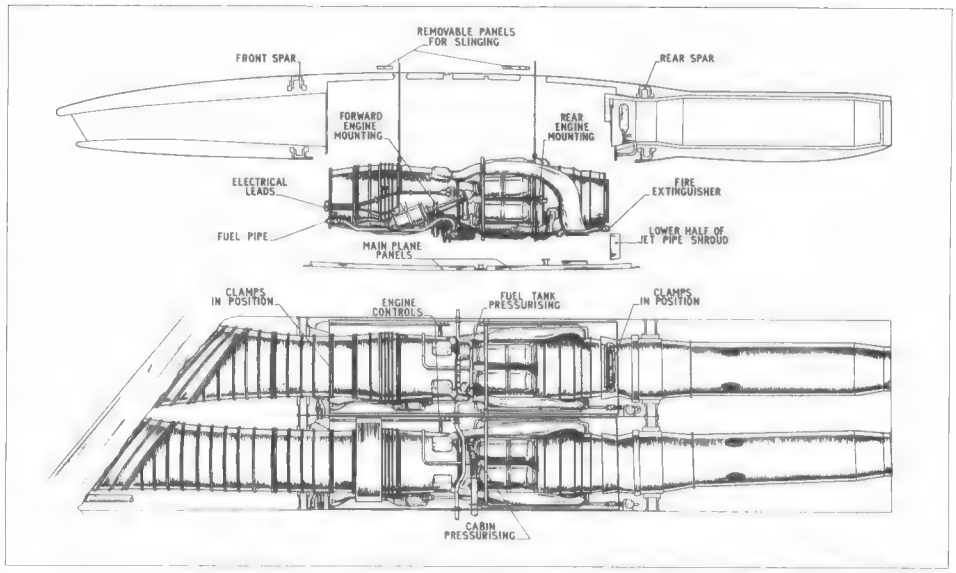
These were now to be joined by the Valiant and it seems that there was not only a staff shortage but a lack of space as well. The problem was eased by shifting the entire Varsity production line to Hurn where the last 89 examples were built.

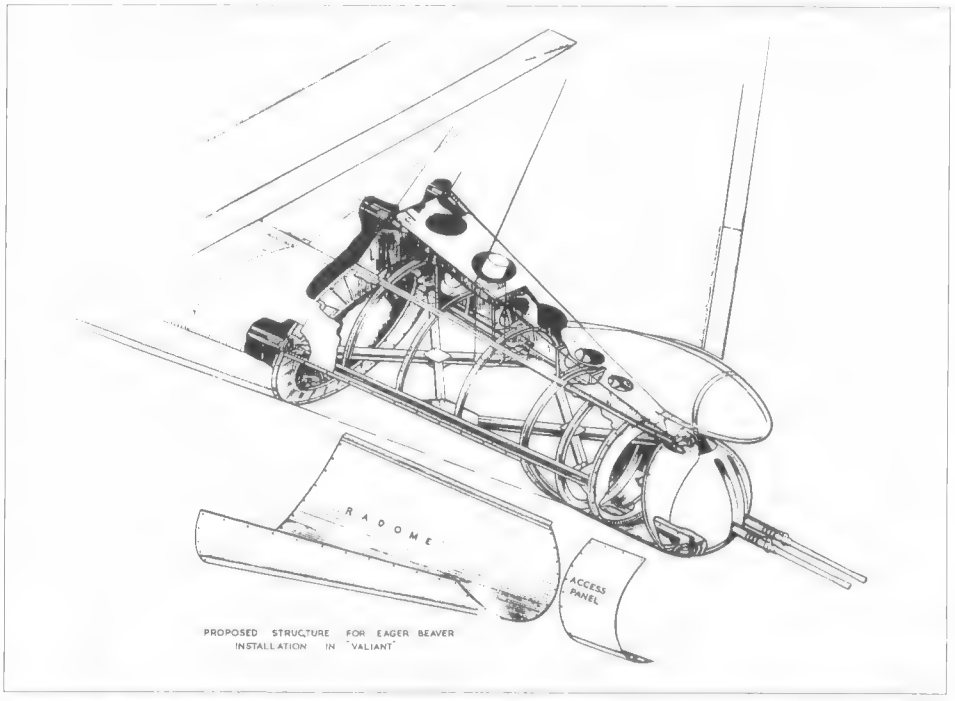
WB210's flying programme recommenced after the three-month break but on 12th January 1952 the aircraft was abandoned in flight after a fire began in the port wing during a set of engine shutdowns and relights – several abortive relights had caused an accumulation of fuel in the wing which caught fire. All the flight crew escaped safely except for the co-pilot, Sqn Ldr B H D Foster DSO, DFC and Bar, whose ejection seat struck the fin resulting in fatal injuries. The other crew members were Prothero Thomas, J N Montgomery and G L Holland and the aircraft crashed near Bramsgrove, Christchurch. Modifications to the atmospheric balance in the fuel system cured the fault for future aircraft which included WB215, still under construction. WB210's total flying time had reached 88 hours.

This accident forced a revision to the Valiant development programme which was discussed with the MoS on 28th January 1952. Vickers proposed to hand-build certain key components for the initial three production aeroplanes, a move which the Air Ministry accepted while promising to hasten Rolls-Royce to get engines ready to meet the new production flight dates of March, May and July respectively. Vickers also wanted the design frozen (i.e. *no* alterations whatsoever over this period) and this too was agreed. At the same time as the new development programme was being worked out, the Air Ministry also stated that it now wanted Blue Boar to be carried on the B Mk.2 instead of the B Mk.1.

George Edwards visited the USA to discuss a defensive tail-mounted armament that would be suitable for the Valiant. In December 1951 the Head of Technical Services at BJSM, Washington, approached the USAF about supplying two tail turrets to fit on Valiants for trials. The US Government authorised this and two were dispatched, arriving in the UK in component form from August 1952. At the same time the Air Ministry issued OR.1116 to cover rear armament defence which was to be in service by the end of 1956. However, discussions suggested that a copy of the US system would probably be unsatisfactory and would take four years to introduce on the Valiant while, because the current capacity for developing electronics was short, it would be 1958 before a new all-British tail armament radar could be developed and produced.

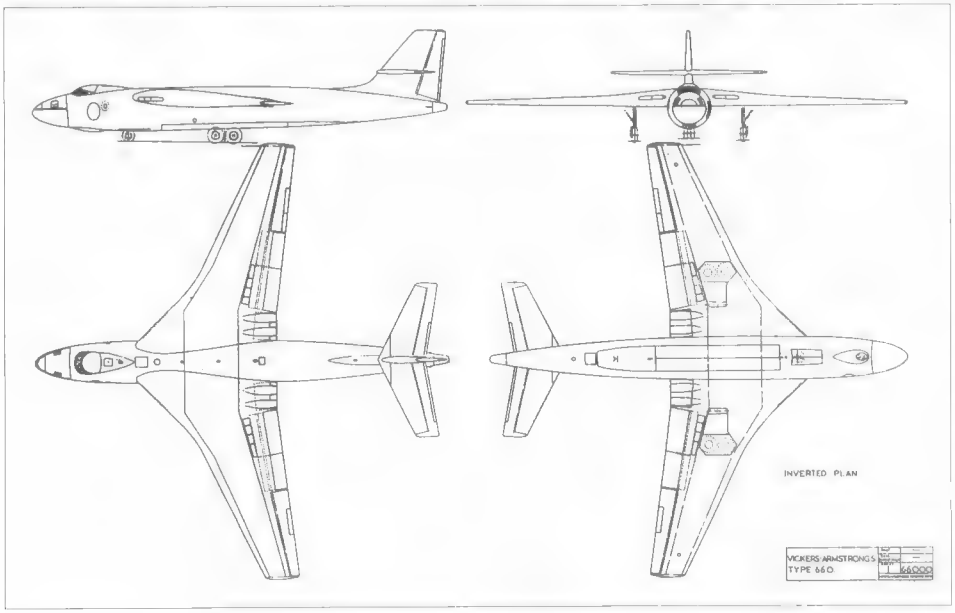
The Air Staff felt that by this time gun defence would be absolutely useless against the types of enemy fighter forecast to be in service; these would be armed with guided weapons that were near impossible to stop with guns. The Air Staff therefore called it a day and in December 1952 took the tail gun radar off the requirement; in March 1953 OR.1116 was itself finally



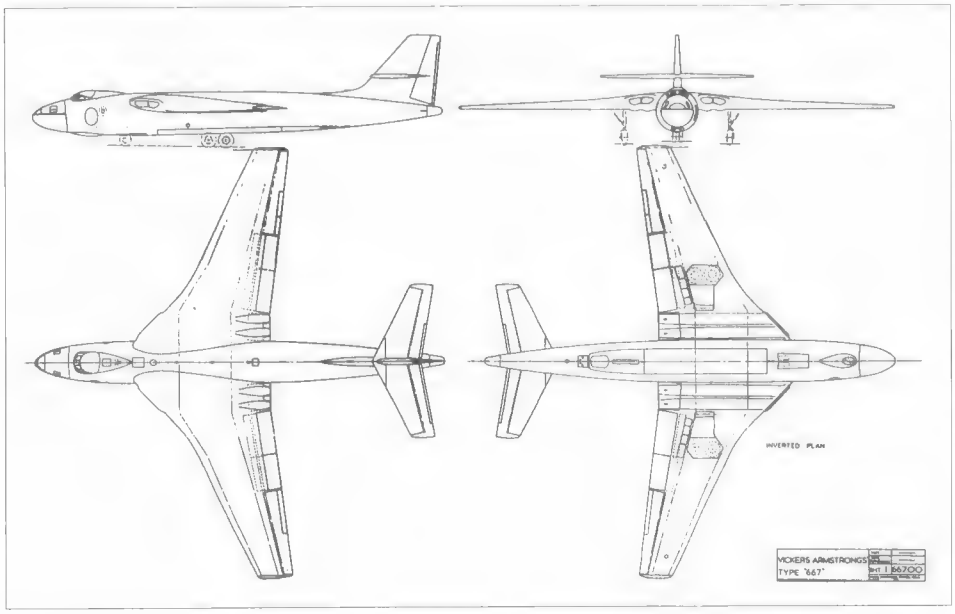


PROPOSED STRUCTURE FOR EAGER BEAVER INSTALLATION IN "VALIANT"

Top: **Four men who were heavily involved with the Valiant programme; left to right: Air Chief Marshal Sir Hugh Lloyd (Commander-in-Chief Bomber Command), George Edwards (Chief Designer), Air Vice Marshal George Harvey (Senior Air Staff Officer Bomber Command) and Air Vice Marshal Geoffrey Tuttle (Assistant Chief of the Air Staff [Operational Requirements]). This picture was taken during a visit by the RAF to Wisley to inspect the second prototype WB215. The exact date of this visit in 1952 is not known but the officers are wearing black armbands to show they are in official mourning for the death of King George VI who had died on 6th February.**



Left: **Drawings of the Vickers Type 660 Valiant first prototype WB210 (dated 4th October 1950) and Type 667 Valiant second prototype WB215. The main external difference between the two aircraft was the air intakes.**

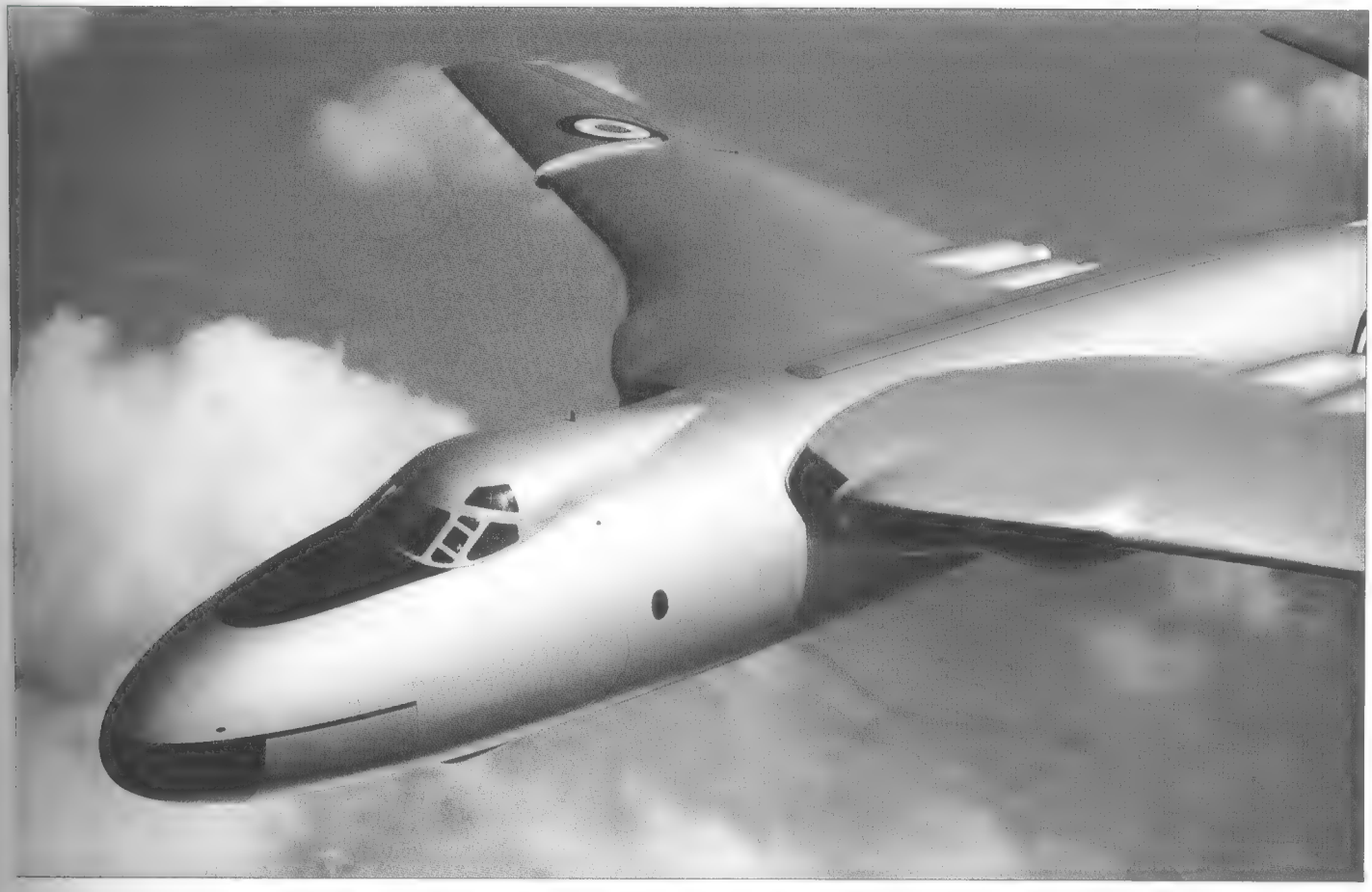


cancelled. Earlier studies made in the UK had included a twin 20mm Hispano cannon tail turret or a single 30mm Aden cannon.

In March 1952 the 66 Valiants on order were raised to 'Superpriority' status. Thanks to the outbreak of the Korean War there was an urgent need to get military aircraft in service quickly and the Government's solution was to select the most important aeroplanes and give them priority over all others with maximum urgency to prevent delay. Whatever means and manpower that were available were to be put onto these critical types but the idea struggled to be effective because the extra skilled staff materials and tooling that it needed were just not available.

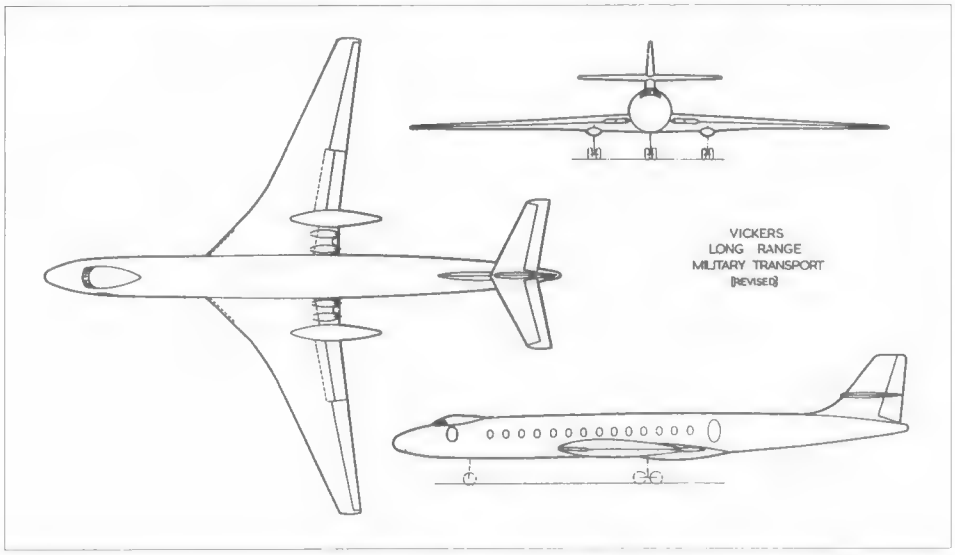
On 11th April 1952 the second prototype WB215, which was called Type 667 to account for certain design changes, first flew at Wisley three months ahead of the original estimate made in 1948. The flight would have been made even earlier if the modifications required following the crash of WB210 had not been needed (the intake for example had been revised). Excessive buffeting was experienced with one engine stopped which put restrictions on the speed and height of subsequent flights. After initial testing at Vickers, the machine went to RAE Farnborough for trials before moving on to Hurn for modification. Further alterations to the air intake successfully eliminated the buffet.

By July 1952 the Air Ministry's Deputy Director of Operational Requirements (DDOR) had changed his mind again in regard to the aircraft's nuclear armament. He now wanted Blue Boar reinstated on some B Mk.1 aircraft because the type would need to carry the weapon on its Service trials. Meanwhile, on the 30th of the month, WB215 was being loaded with a dummy Blue Danube when the store was inadvertently released and fell back onto the ground (a good job it was not the real thing). The cause of this release was traced to the



Top and centre: **Close-ups of WB215's forward fuselage and enlarged 'spectacle' intakes.**

Bottom: **WB215 as it first appeared with plain polished metal finish. Photographed on landing, this view clearly shows the large-area flaps.**



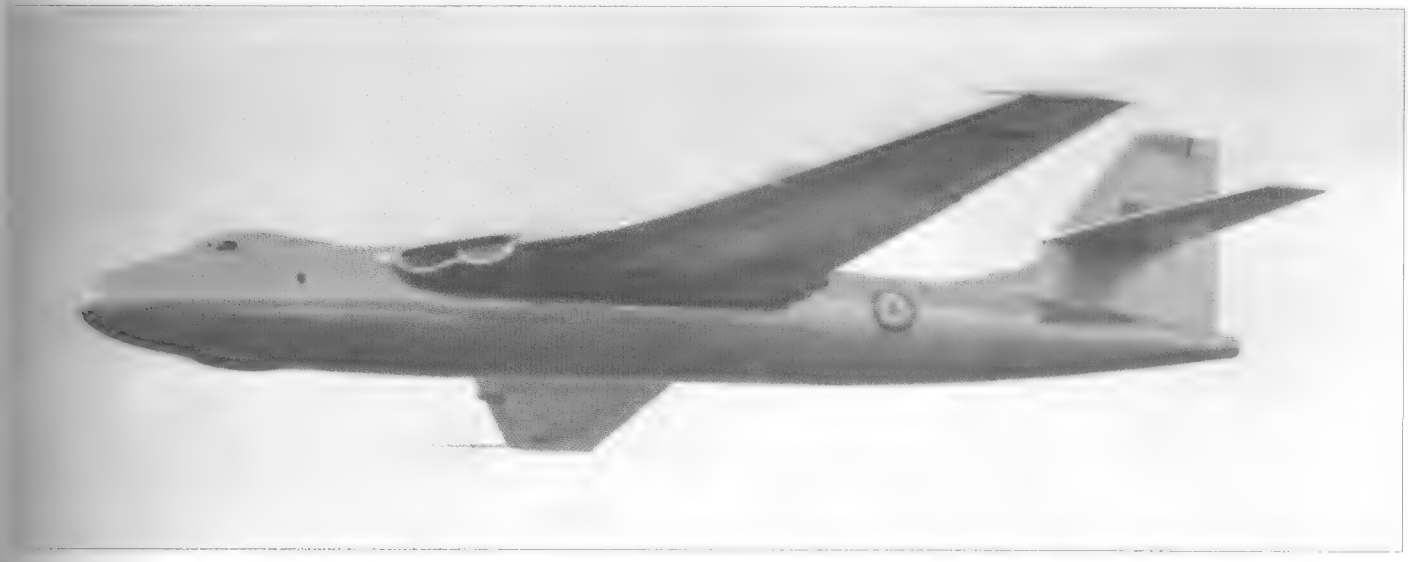
Above: **Ground testing underway on an early Valiant, possibly WB215.**

Left: **During the Valiant's development, Vickers looked at transporting troops over long distances and eventually produced a project for a long-range military transport which used the bomber's fuselage. However, adapting the bomb bay and making it fully pressurised presented a problem in that a soldier could not stand upright in the aircraft. The project was then given a more conventional airliner fuselage with passenger windows but retaining the bomber's wing (drawing 65550/2). This was later used as an initial scheme towards the Type 1000 airliner (Appendix 4).**

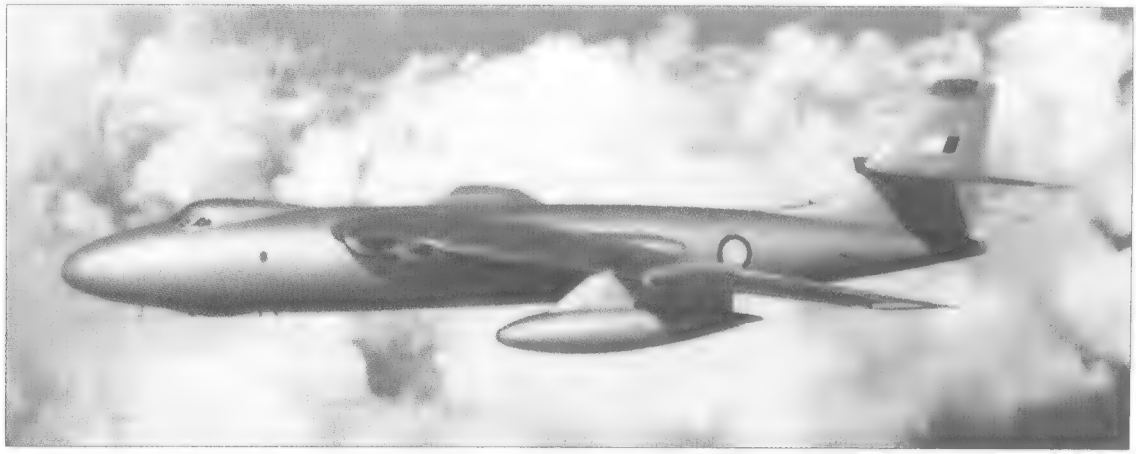
bomb slip itself and during the subsequent investigation it was found possible to reproduce both inadvertent and delayed releases of the bomb slip.

During WB215's performance trials with the initial 7,500 lb (33.3kN) R.A.7s, rate of climb was found to fall off rapidly above 35,000ft (10,668m) when operating at a take-off weight of 110,000 lb (49,896kg); at this weight the rate of climb at 42,000ft (12,802m) was approximately 200ft/min to 300ft/min (61m/min to 91m/min) at 200 knots (371km/h) IAS. To reach greater heights it was found necessary to level out, allow the aircraft to accelerate and then pull the nose up to gain more altitude and this method had to be employed to get the aeroplane to reach 45,000ft (13,716m). When assessing lateral stability it was found that considerable attention was required to fly the aircraft accurately with wings level at 40,000ft (12,192m) and above, especially at indicated airspeeds below 200 knots, while the aircraft would tend to 'wander' and be displaced directionally at the same time. It was thought that this wandering was aggravated by the pilot getting out of phase laterally, which may have been due to a backlash in the aileron circuit.

Bomb door operation sounds a simple thing but it did cause a few problems on WB215. Prior to commencing the bomb dropping trials the doors were opened and closed at speeds up to and including 300 knots (560km/h) IAS with the bomb bay empty (bar some wat tanks that were used as ballast to bring the a craft up to its operating weight). These te were repeated after fitting a bomb bay leadin edge spoiler that was used when droppi Blue Danube. Only once did the system bre down when the starboard door failed to open 300 knots due to a defective operating mot On one flight the 'Special Bomb' (a term us to hide the fact that it was nuclear) came off t bomb slip but the doors held the weight approximately ten minutes until they we opened. Bomb dropping actually commenc on 2nd July 1952 using a total of nine 1,00 (454kg) bombs loaded in threes – front, cen and rear.



Top and above: **The second prototype, WB215 is seen making flypasts at the September 1952 Farnborough Air Show to show its clean, slim wing and new-style intakes.**



Right: **WB215 fitted with two long-range drop tanks for the New Zealand Air Race.**

A summary of 'bomb dropping' flights in July 1952, given at the bottom of this page, shows that not every sortie was a success.

When George Edwards was designing the B.9/48 he wanted all the systems on it to be powered by electric motors; only the brakes and steering gear retained hydraulic power although even the pumps for these were electric. In making this move Edwards took a big step and it meant that the Valiant broke new ground by having all-electric systems; replacing the old 28 volt DC system with a 112 volt DC system also saved weight. However, an all-electric aircraft generated its own design problems, with corona discharge on the generator brushes occurring when flying at height, so the type had to be restricted to flying below 40,000ft (12,192m), or for less than half an hour above that limit, until modified brushes known as EGX10 were fitted to all of the generators, rotary transformers and power control motors.

After these were fitted the Valiant was authorised to fly at altitude for four to five hours duration provided that flight times were extended progressively and the brushes were examined after each flight. The trouble with all this electrical 'stuff' was that the currents flowing in the different systems might interact with one another which could set up eddy currents that then interfered with other equipment. A great deal of extra testing was needed to ensure that everything would work satisfactorily without complications.

In September 1952 WB215 went to RAE Farnborough where it attended the SBAC Air Show. Back in June the Air Ministry had provisionally authorised that WB215 could take part in the England to New Zealand Air Race which was scheduled to take place in October 1953. However, in October 1952 WB215 was damaged when its port undercarriage retracted on landing. The pilot was unable to lock the port main chassis and, after trying every way of securing it, he was forced to land in this condition. Towards the end of the landing run the port chassis started to collapse but, by using aileron and starboard brake, the pilot stopped the wing tip from touching the ground until the aircraft was moving at a speed akin to normal taxying speed. The port flaps suffered considerable damage but the wing itself was not seriously harmed.

WB215 was repaired by April 1953 and also fitted with the uprated Avon R.A.14s and drop tanks ready for the New Zealand flight. The aircraft had to have extensive flight trials to clear the carriage of drop tanks, RATOG, fuel jettisoning and bomb bay fuel. In December the Air Ministry confirmed its decision to enter the aircraft and on 24th July 1953 WB215 was grounded to prepare it as a contestant. The required alterations were completed by 25th September and 13 hours of flying were carried out in this configuration. However, the Air Council decided to withdraw WB215 from the contest because this number of hours was considered to be insufficient for a new aircraft and there was insufficient time to complete the rest of the necessary flight trials. In addition the Valiant had not yet been flown in tropical conditions so WB215 was denied the chance of being the first Valiant to go overseas. (Further details of the race itself and the work needed to prepare the Valiant to take part are given in Appendix 6.)

By now WB215 had been flown to 370 knots (686km/h) IAS with the drop tanks fitted and regularly to a Mach number of 0.84. During a flight from A&AEE the Mach number was taken well over 0.84 by a Boscombe Down pilot before the aircraft reached Mach 0.88 in a spiral. At this point a very severe buffet appeared which necessitated the pilot closing the throttles and operating the dive brakes; investigations afterwards indicated that the buffet was caused by the starboard chassis door opening.

One of many flight tests to be carried out was to assess the effect of the wing fuel tanks and see if their introduction had in any way adversely affected the handling characteristics during the approach and landing. The tanks held 1,500 gallons (6,685 lit) each while an extra 2,000 gallon (8,914 lit) tank had been inserted in the bomb bay to give all-up-weight of 166,500 lb (75,524kg). During the second flight after these had been fitted, the lateral and directional stability of the aircraft was tested in the landing configuration (i.e. flaps 40°, chassis down) at 120 knots (222km/h) and 150 knots (278km/h). These showed that the aircraft was laterally stable but slightly spirally unstable and that lateral control in turbulent conditions was quite acceptable.

At this all-up-weight the use of water/methanol injection was a must and despite only giving 55 seconds of extra power, it was enough to get the aircraft to approximately 100ft to 200ft (30.5m to 61m). On the first take-off the pilot lifted from the ground at 150 knots (278km/h), on the second the take-off speed was reduced to 140 knots (259km/h) and on the third it was cut to 133 knots (246km/h), at which point it had become an effort to pull the Valiant off the ground. The stalling speed was found to be 122 knots (226km/h) IAS at 123,750 lb (56,133kg), with 20° flap this was reduced to 103 knots (191km/h) IAS; at 122,000 lb (55,339kg), with 30° flap the figure was 102 knots (189km/h); at 121,000 lb (54,886kg) with 40° flap the figure was 99 knots (183km/h); at 120,000 lb (54,432kg) and finally with full flap the stall was 100 knots (185km/h) IAS at 119,000 lb (53,978kg). Boscombe Down's pilots reported 'at the stall in all configurations [the aircraft] is extremely majestic and wing drop and nose drop, although marked, are not vicious'.

Vickers, Rolls-Royce and the MoS met in October 1952 to sort out problems with the Superpriority scheme. Despite the priority programme, the R.A.14 engines would not be ready for installation as promised and, in fact, it would be at least three months before they would be available. On 13th October another meeting at Vickers House in London discussed an RCM (Radio Counter Measures) installation. Air Ministry policy was that this should be fitted to all Valiants but, at this time, one wonders if they knew what they were letting themselves in for because this equipment was large, very heavy and would need its own electrical generators; such an installation would be a major engineering undertaking.

In August 1952 the Government put the squeeze on the Air Ministry to reduce its future financial commitments. In consequence, all aircraft orders were scrutinised and the rule was if it had not been started, chop it. Thus in the case of the Valiant, the order for 17 B Mk.2 aircraft (see Chapter 3) was cancelled but at least it was changed to an equal number of B Mk.1s. This resulted in a considerable saving in money because the B Mk.1s could be produced a lot more quickly since they were essentially the

Date	Drop Height, ft (m)	IAS, knots (km/h)	Result
9 July	10,000 (3,048)	160 (296)	Successful
9 July	1,000 (305)	80 (148)	Successful
10 July	1,000 (305)	200 (371)	Successful
10 July	1.000 (305)	200 (371)	Successful
11 July	1,000 (305)	220 (408)	Store hung up for 8 to 9 seconds.
11 July	1,000 (305)	220 (408)	Store hung up for 8 to 9 seconds.
22 July	1,000 (305)	200 (371)	Successful
23 July	Aborted		Aircraft returned to base because of vibration experienced from aft of the rear pressure bulkhead. This could not be reproduced on the ground and did not recur.
28 July	1,000 (305)	220 (408)	Successful
28 July	1,000 (305)	240 (445)	Store hung up for 3 to 4 seconds and the Lanyard attachment bracket was broken. Store fell off slip en route to Range. The bomb doors were opened over the sea and the store was dropped into the Thames Estuary. The aircraft landed at Manston where it was found that the bomb doors had been severely damaged but the rest of the aircraft was pretty well untouched.
30 July	Aborted		

Photographs on the opposite page:

Top: **About a dozen Valiant fuselages plus wings can be seen in this picture of the Weybridge production shops.**

Bottom: **The scene looking towards the production shop doors.**

View from outside the production shop looking in through the open doors. An unidentified Valiant will soon be ready for its maiden flight.

continuation of an existing order. During the following month both the photo-reconnaissance variant to OR.279 (see Chapter 3) and the OR.285 target marker were cancelled.

It was agreed, however, that since one B Mk.2 had already been ordered and was now 60% built, this should be completed and used to help finish the B Mk.1's clearance trials. The Treasury was, however, requested to approve the placing of an additional order for 56 Valiant B Mk.1s; the Department took its time but finally authorised the payment in April 1953. Most of these were to become Valiant B(K) Mk.1s (Vickers Type 758 with Avon R.A.28s) and were serialled XD812 to XD830 and XD857 to XD893; XD876 to XD893 were cancelled in early 1956 as a result of a Defence Review.

By 1st November 1952 the test programme had accomplished much. A total of 220 hours flying had been completed on both prototypes and the second aircraft had taken off at 120,000 lb (54,432kg) weight carrying a model Blue Danube ballasted with concrete to make it the same size and shape and a very similar weight to the real thing. This 'Blue Danube' had been dropped at speeds up to 240 knots (445km/h) IAS while 1,000 lb (454kg) bombs had been released at up to 300 knots (556km/h) IAS. An altitude of 45,000ft (13,716m) had been reached using Rolls-Royce R.A.7 Avon engines that gave only 7,500 lb (33.3kN) of static thrust, an indicated Mach Number of 0.835 had been attained and the aircraft had been taken to its design diving speed of 390 knots (723km/h). Flapless landings had also been carried out.

During an inspection of WB215 in May 1953, extensive fatigue cracking was found in the rear fuselage and the aircraft was grounded for investigation. Afterwards the prototype went back to Wisley and a further 33 flying hours were completed before more cracks appeared. Vickers was dismayed by these events and its Acoustics Department was stretched to find the real cause (the effects of the sound energy emanating from the jet effluxes) and a cure. Solving the problem fully eventually took about 12 months.

During October and November WB215 evaluated some fluted tail pipes which had been designed to eliminate the resonance that was creating the fuselage fatigue cracks (they were also partly to clear it for the New Zealand Air Race). In the same period the B Mk.2 prototype completed some 30 hours flying towards the investigation into fuselage vibration while also continuing to test the engineering features of the B Mk.1. By December WB215 had accumulated 247 flying hours and during that month made some take-offs using water methanol power augmentation at weights up to 167,000 lb (75,751kg). However, these tests had to be curtailed because of the lack of suitably modified engines.

Returning to the in-flight refuelling investiga tion begun in May 1951, in December 1952 th Air Ministry asked the MoS for three Valiants t be modified as tankers/receivers to allow th system to be evaluated. Some time passed however, before a contract was forthcomin but it was finally issued in September 1953 wi three production aircraft being allocated fo conversion. In January 1953 Vickers was aske to start the design of a flight refuelling syste and a month later the firm had fitted a 500 ga lon (2,273 lit) fuel tank into the bomb bay of B Mk.1 which was similar to the tank propose for its PR designs. This had little effect on pe formance, except of course that the range wa increased. As a result the Air Staff quick requested that all Valiants should be th equipped and the modification was introduce to the production line from the sixth aircra onwards.

Following discussions concerning thru augmentation to reduce the Valiant's take-o run in the overload condition, both wat methanol injection and RATOG had bee examined closely. In March 1953 the Air Sta stated a definite requirement to have both intro duced onto the aircraft as soon as possible.

The Black Bomber
B Mk.2 and other Proposals

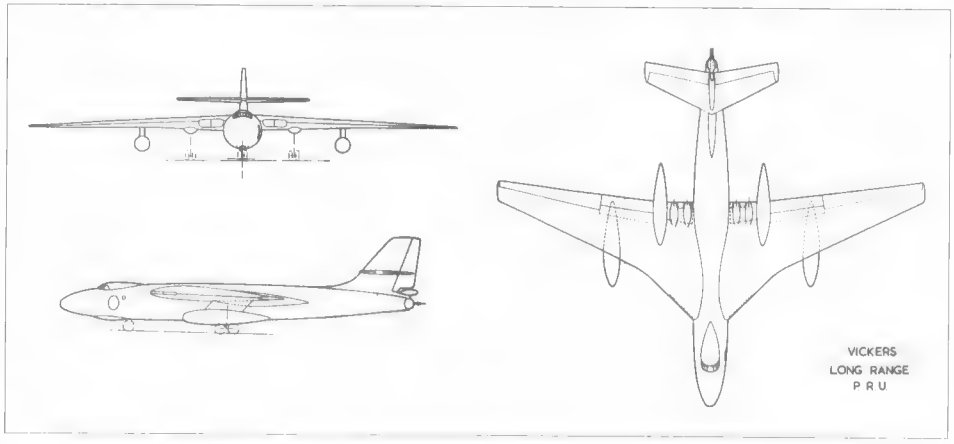
As well as the basic Valiant B Mk.1, Vickers was now also working on two specialist developments, the first brochures describing them having been detailed in Chapter 1. The company's document for a long-range PRU (photo-reconnaissance unit) aircraft was issued in January 1951 but in September the Air Ministry released the Draft OR.279 which called for production PR Valiants to be in service in 1954 with additional crew and equipment. This move brought extra weight and affected the performance so much that a complete revision of the brochure was needed. This project showed a new type of aircraft to work in conjunction with the B.9/48 and B.104 Valiants (the latter was the Air Ministry specification covering the B.9/48 Pathfinder described shortly).

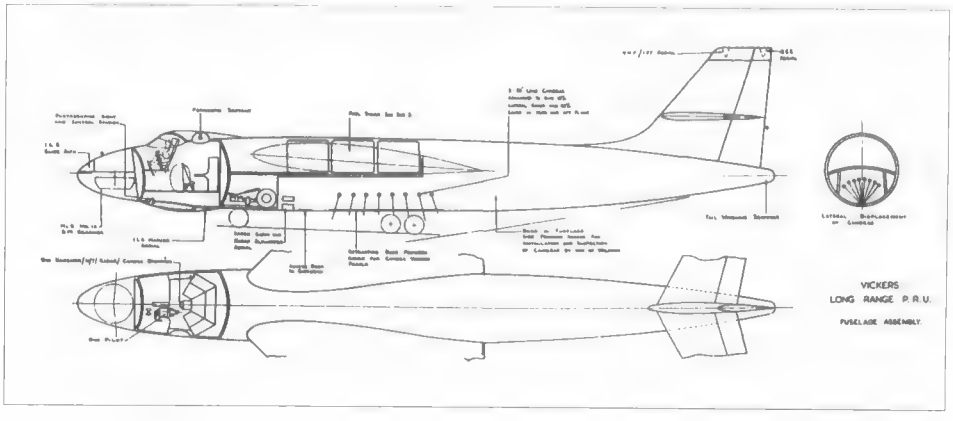
Earlier, on 27th September 1950, a Draft OR.287 for a long-range PR aircraft had been issued which called for an entirely new type with supersonic capability and an exceptionally high ceiling. The document was passed to Vickers who noted that 'part of the task of a photographic reconnaissance force is to get the photographic intelligence needed for bomber operations, including radar photography. To do this a PR aircraft needs a range of at least 20% in excess of contemporary bombers. We have the Canberra PR Mk.3 to match the Canberra bomber, and we need a PR aircraft to match the B.9/48 and the B.104D. This is beyond the capabilities of the Canberra PR.3, particularly as it is not equipped for radar photography, and a new type of aircraft, even of conventional design, could not be produced by the time it is required. In order to fill this gap with the least possible delay the Air Staff must therefore ask for a variant of a current development.' A version of the Valiant adapted for PR work was the result and OR.287 was dropped.

The aircraft was originally to have a crew of two and lacked airframe de-icing but it was felt that the revised design should be brought more into line with normal bomber and pathfinder aircraft. This new type would have a standard B.9/48 fuselage but the bomb doors would be replaced with camera servicing doors; the wings would be new with an extra 16ft (4.9m) on the span. The favoured engine was the 11,500 lb (51.1kN) Rolls-Royce Conway Co.3 which gave a better specific fuel consumption than the 9,250 lb (41.1kN) Conway Co.2. Range would be 6,000 miles (9,654km) in the day role or 4,000nm (7,412km) at night and ceiling over the target 50,000ft (15,240m). OR.279's extra crew and equipment brought the following increases in weight – two crew 380 lb (172kg), extra items to accommodate these crew members 350 lb (159kg), rear defence 2,250 lb (1,021kg), extra cameras 2,200 lb (998kg) and full airframe de-icing 500 lb (227kg); in all this gave a total extra weight of some 5,680 lb (2,576kg).

The camera fittings would comprise an interim installation in the day role of ten F.52s with 36in (91.4cm) lenses in the fuselage to give 10% overlap with a total coverage of not less than 100°. When the FX.96 camera with 48in (122cm) or 36in lenses became available, ten of these would replace the F.52s along with either two more F.52s with 20in (50cm) lenses for oblique photography or three F.49s with 6in (15.2cm) lenses. For the night role it was assumed that the drop tanks would be replaced by cocoons carrying the necessary HTV flares while six FX.89 Mk.3 night cameras and six photo-electric cells would be carried, or up to five FX.89 Mk.3s fitted with 36in (91.4cm) or 24in (61cm) lenses. To assist take-offs at the fully loaded weight of 183,000 lb (83,009kg), which included 96,000 lb (43,546kg) of fuel, the aircraft would be fitted with 14 3,000 lb (13.3kN) jettisonable rocket boosters with a burn time of six seconds. Maximum range would be 7,460nm (13,823km) at 462 knots (856km/h).

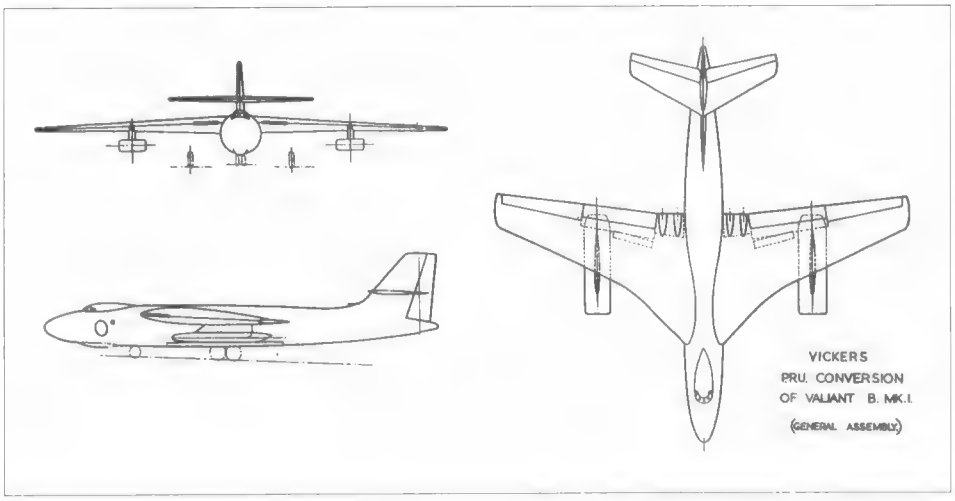
The PR aircraft was the subject of an OR Committee Meeting in September 1951 when the draft OR.279 was discussed. The MoS said that it was unlikely that Vickers could meet the in-service target date of 1954; March 1955 was more likely. In response the Air Staff asked the MoS to examine the possibility of providing six interim PR aircraft by introducing a simple modification to standard B Mk.1s. OR.279 was officially issued on 17th October 1951 and in November the MoS informed the Air Staff that





Top right: **Vickers Long-Range PRU aircraft showing pods, fuel tanks and tail armament (Drawing 65551 Sheet 1).**

Right: **Vickers Long-Range PRU aircraft fuselage assembly showing the eight 56in (142cm) camera arrangement (Drawing 65547/2).**



Valiants with special PR conversion sets – a package of cameras and their associated equipment fitted in the bomb bay that would turn a B Mk.1 into a PR Mk.1 (later reclassified as B(PR) Mk.1) – could be available in 1954. In September 1952 the dedicated PR Valiant to OR.279 was dropped and the decision taken to order PR conversion sets for B Mk.1 aircraft.

Vickers' latest proposals for a Pathfinder version of the Valiant had been submitted in September 1950 and specification B.104 was subsequently written around them. The aircraft was required to carry 6,000 lb (2,722kg) of Target Indicators and to have the 3,350nm (6,208km) range of the B Mk.1 but with an additional capacity to search at low level near the target. In order that the maximum protection should be afforded the pilot when emerging from the target area, no structural limitation on top speed at sea level was imposed and the design diving speed was set at 580 knots (1,075km/h). This extra flexibility was an attractive feature and it was felt justified to make the aeroplane carry the full range of bombs available on the B Mk.1; hence the Pathfinder became a high and low-level bomber with a maximum bomb load of 41,000 lb (18,598kg) that could be taken for a distance of over 4,000nm (7,412km) at altitude.

The high structural strength required by the 580 knots dive speed brought severe penalties in structural weight over the B Mk.1. A maximum weight of 210,000 lb (95,256kg) was envisaged with Conway Co.3 engines and at this weight a huge range of over 6,000nm (11,118km) was possible with 10,000 lb (4,536kg) of bombs (performance figures are given in the tables on the opposite page, which also include data for Rolls-Royce Avon R.A.14 powerplants). A production order for 17 B Mk.2 aircraft was eventually placed with Vickers who proposed the following manufacturing programme:

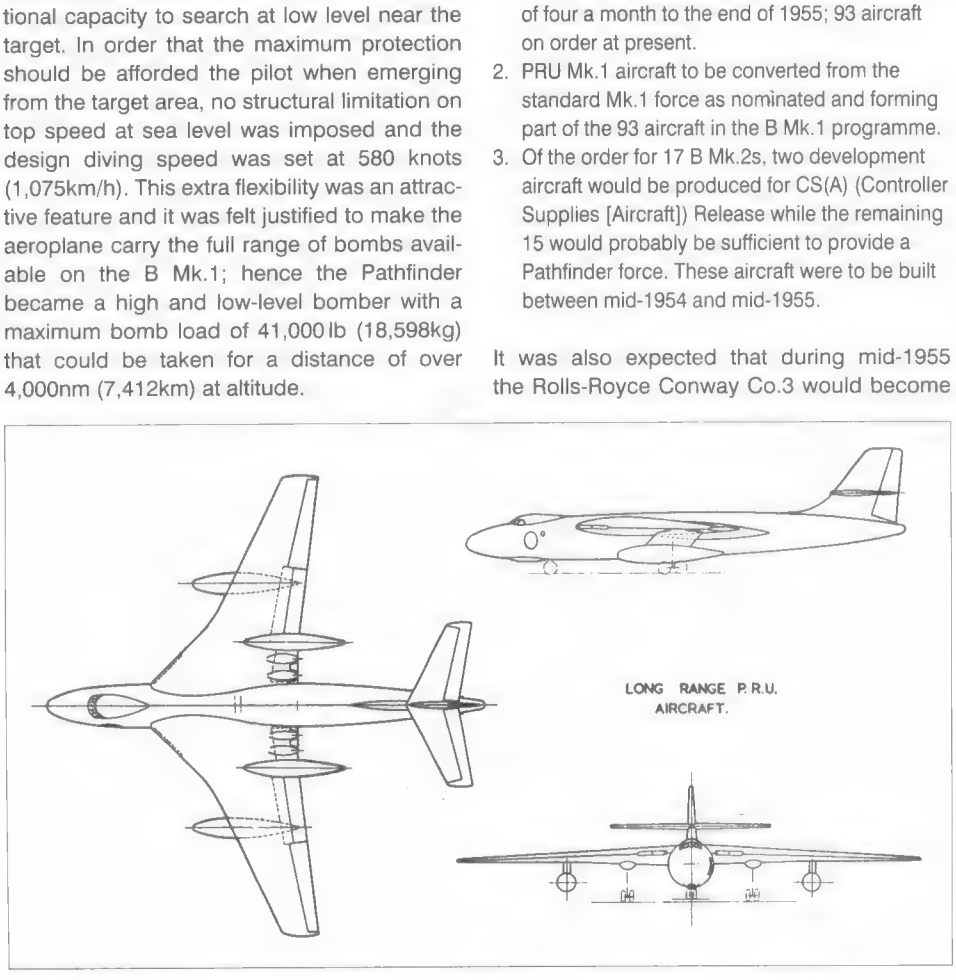
1. Production of B Mk.1s powered by Avon R.A.14s recommended to continue at the rate of four a month to the end of 1955; 93 aircraft on order at present.
2. PRU Mk.1 aircraft to be converted from the standard Mk.1 force as nominated and forming part of the 93 aircraft in the B Mk.1 programme.
3. Of the order for 17 B Mk.2s, two development aircraft would be produced for CS(A) (Controller Supplies [Aircraft]) Release while the remaining 15 would probably be sufficient to provide a Pathfinder force. These aircraft were to be built between mid-1954 and mid-1955.

It was also expected that during mid-1955 the Rolls-Royce Conway Co.3 would become available offering 12,000 lb (53.3kN) of static thrust, and it was hoped that a mark of Valiant could be introduced at this time which would enable the extra power of this engine to be exploited. The only significant change would be a more highly swept outer plane. A new production programme with Conway 3 engines was suggested, the mark numbers being amended to reflect the change:

1. B Mk.1?. This would be the counterpart of the B Mk.1 with a speed restriction below 20,000ft (6,096m) and a design diving speed of 390 knots (723km/h), but it would have a significantly higher performance as the accompanying tables show. Cruising speed would be 490 knots (908km/h) at 49,000ft (14,935m) compared with the B Mk.1's 468 knots (867km/h) at 49,000ft. The still-air range when carrying a 10,000 lb (4,536kg) bomb but without drop tanks would be 5,000nm (9,265km); with drop tanks 6,400nm (11,859km). A number of these aeroplanes could be converted to photo-reconnaissance in the same way as with the Avon-powered B Mk.1, giving the performance figures shown in the table.
2. B Mk.2?. This would be a development of the B Mk.2 but would probably have a design diving speed of no higher than 490 knots (908km/h) since it was felt that the B Mk.2's 580 knots (1,075km/h) had placed a disproportionate penalty on the structural weight. This aircraft could again be used as a bomber as well as a pathfinder.

Production of these 'Half-Marks' could begin in mid-1953 and be complete by the end of 1956 a total of some 80 aircraft would be involved.

In September 1950 a requisition was raised for one prototype Medium-Range Target Marker Valiant to specification B.104D but it was not released until November. B.104D was issued to Vickers on the 8th of that month and requested the design and construction of a prototype 'but the design shall be suitable for large scale production under wartime conditions'. At low levels the marking accuracy, both blind and visual, had to be of the order of 100 yards (91m); at high levels an accuracy of 400 yards (366m) was acceptable. A comparable endurance to the B.9/48 Valiant medium bomber was expected but with the manoeuvrability to enable markers to be placed within the limits of accuracy quoted. The flight conditions under which the target marker would operate called for 'structural adjustments' to the basic Valiant and, in the interest of performance, the Air Staff was prepared to forego orthodox defensive armament.



Top: **PR conversion of Valiant B Mk.1 with cameras fitted in cocoons. The bomb bay carried extra fuel (Drawing 65554 Sheet 1).**

Bottom: **The complete Long-Range PRU aircraft, what we now know as the Valiant B Mk.2 (Drawing 65547/1).**

Opposite page, bottom: **This view of WJ954 in flight shows its lengthened nose to good effect**

The specification also requested the following:

1. A maximum cruising speed of not less than 450 knots (834km/h) TAS at 45,000ft (13,716m);
2. A service limiting diving speed of at least 500 knots (927km/h) EAS between sea level and 15,000ft (4,572m);
3. Still-air range to be at least 3,350nm (6,208km) including descent and manoeuvres;
4. Engines to be Rolls-Royce Avon R.A.3/1 but with provision for conversion to Conway, Sapphire or Olympus;
5. Target Indicator Load to be four 1,000 lb (454kg) target indicators or 1,000 lb flare clusters or a mix of these stores up to a total of 6,000 lb (2,724kg);
6. An alternative warload comprised one special (nuclear) bomb, one 10,000 lb (4,536kg) HC, two 5,000 lb (2,268kg) HC, 21 1,000 lb (454kg) MC, two 5,000 lb Blue Boar weapons, one 10,000 lb Blue Boar or 21 1,000 lb mines.

The Target Marker 'Pathfinder' was soon redesignated Valiant B Mk.2 and specification B.104P was issued on 10th November 1951 to cover production B Mk.2s to OR.285; back in April the prototype was expected to fly in December 1952. Handley Page also produced a scheme to B.104 in the form of its HP.98 Target Marker project powered by four 11,500 lb (51.1kN) Rolls-Royce Conway 3s which had 20% thrust boost from water methanol injection. This design was in effect a pathfinder development of the HP.80 Victor Medium Bomber to B.35/46 and would have been armed with remotely controlled radar-sighted tail guns for low-altitude operations.

The prototype Vickers Type 673 Valiant B Mk.2, WJ954, made its first flight on 4th September 1953 from Wisley. As explained in Chapter 2, by the time it flew the Target Marker OR.285 requirement had been cancelled but WJ954 was used to help the B Mk.1 programme as far as possible. It was first flown by G R Bryce, Vickers Weybridge Chief Test Pilot, who was accompanied on the trip by the Assistant Chief Test Pilot Brian Trubshaw and a flight test crew. The biggest difference to the B Mk.1

B O M B E R S.

BOMB LOAD.			B. MK.I AVON R.A.14 ENGINES.	B. MK.II AVON R.A.14 ENGINES.	B.MK.I½ CONWAY Co3 ENGINES	B.MK.II½ CONWAY Co3 ENGINES.
10,000 lb.	Cruising Speed.	Kts.	468	467	491	491
	Height over Target	Ft.	49,000	46,000	49,000	47,800
	Range (1)	N.Miles	3,350	3,350	3,350	3,350
	Cruising Speed.	Kts.	468	467	491	491
	Height over Target	Ft.	47,200	44,200	45,000	43,500
	Range (2)	N.Miles	5,000	4,650	6,400	6,560
21,000 lb.	Cruising Speed.	Kts.	468	467	491	491
	Height over Target	Ft.	46,000	43,000	44,100	42,700
	Range	N.Miles	4,150	3,900	5,660	5,820
41,000 lb.	Cruising Speed.	Kts.	446	446	453	453
	Height over target	Ft.	41,000	38,500	38,700	37,500
	Range	N.Miles	2,000	1,950	3,290	3,500
	A.U.W.	lbs.	159,800	172,000	188,000	201,300
	Vd.	Knots EAS.	390	580	390	490
	Factor		4.0	5.25	4.0	4.0

Heights are over target with bombs on.

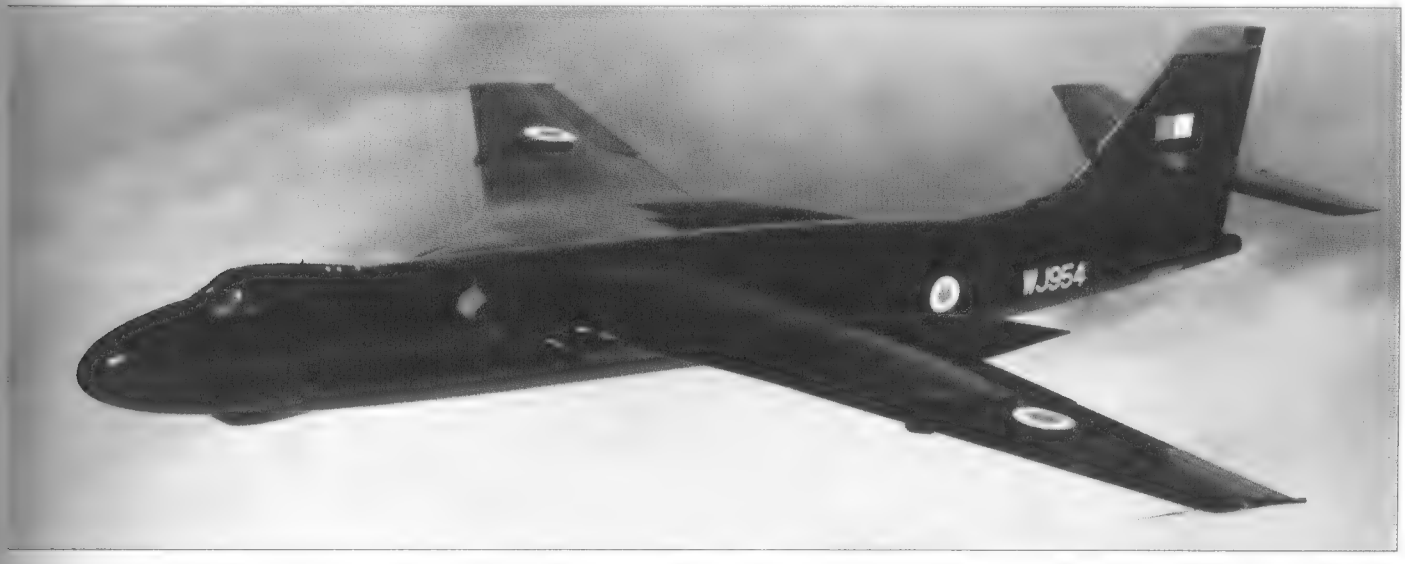
(1) Specification Range
(2) Range on maximum fuel

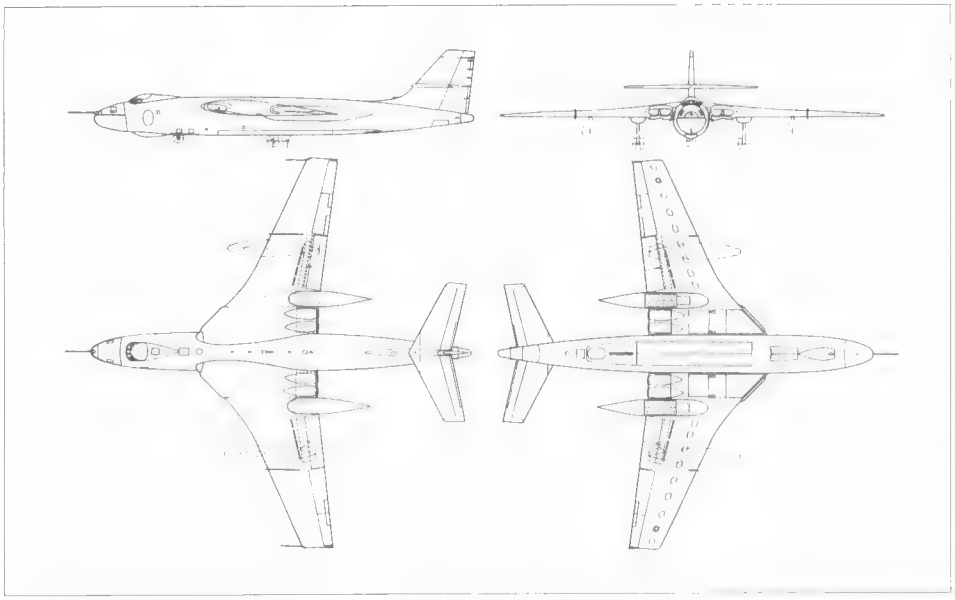
P. R. U.

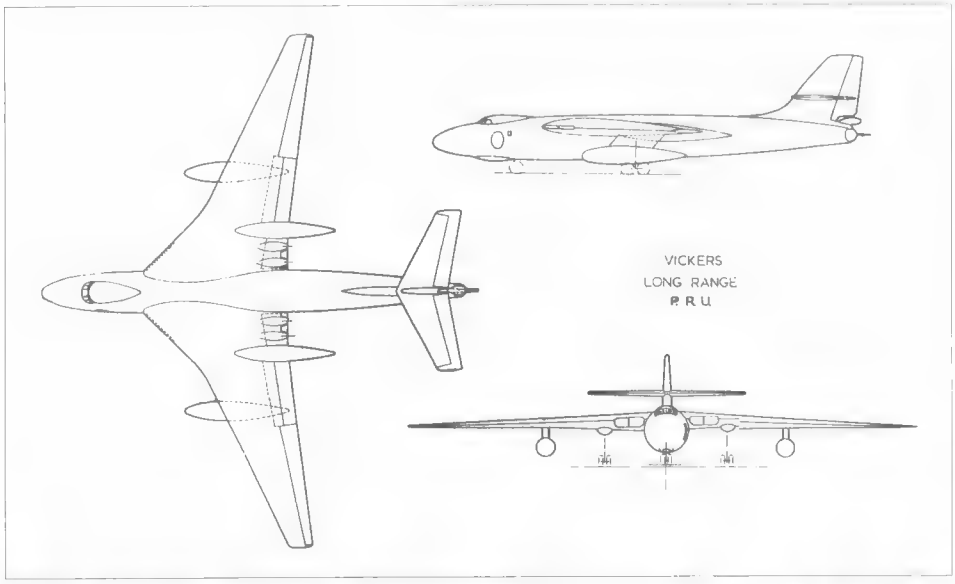
		B. MK. I R. A. 14 ENGINES.	B. MK. I½ Co3 ENGINES.
Cruising Speed.	Kts.	454	475
Weight over Target	Ft.	48,500	47,500
Range	N.Miles	5,700	6,600
A. U. Weight.	lbs.	161,000	181,000
Vd.	Knots EAS.	390	390
Factor		4.0	4.0

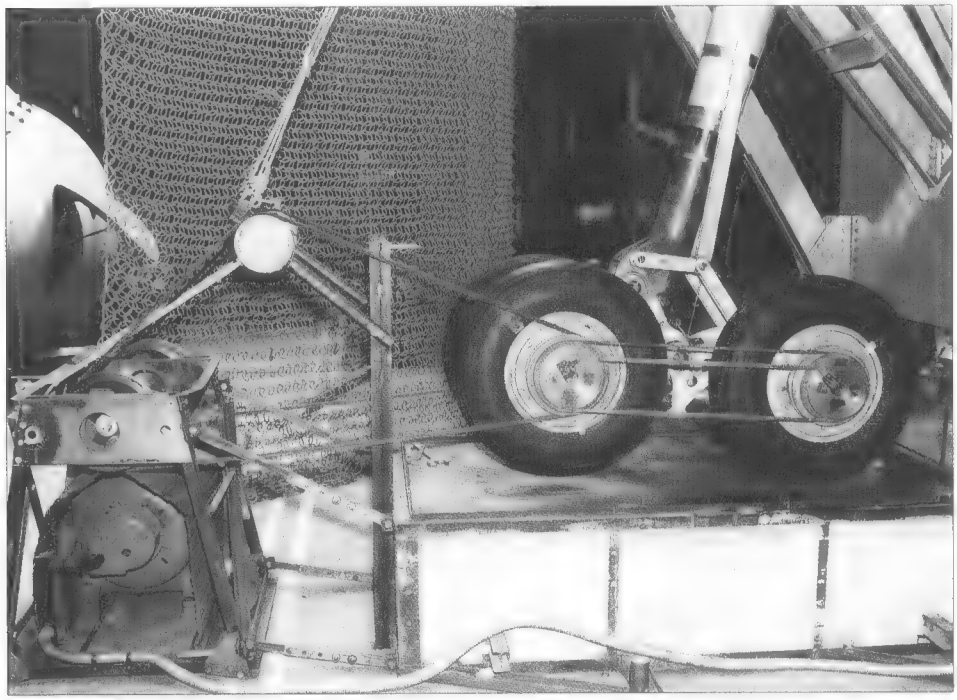
P A T H F I N D E R S.

		B. MK. II R.A.14 ENGINES.	B. MK. II½ Co3 ENGINES.
Cruising Speed.	Kts.	467	491
Height over Target.	Ft.	45,000	44,500
Range	N.Miles	4,000	5,900
A. U. Weight	lbs.	172,000	197,300
Vd.	Knots EAS.	580	490
Factor		5.25	4.0









Top: **Four-view drawing of the Type 673 Valiant B Mk.2 with a in-flight refuelling nose probe, cocoons, wing tanks, nose extension and four-wheel bogie undercarriage.**

Centre: **PRU version of the B Mk.2 with a larger wingspan and fitted with the 'Eager Beaver' tail defence system.**

Bottom: **Close-up of the B Mk.2's four-wheel main gear under test.**

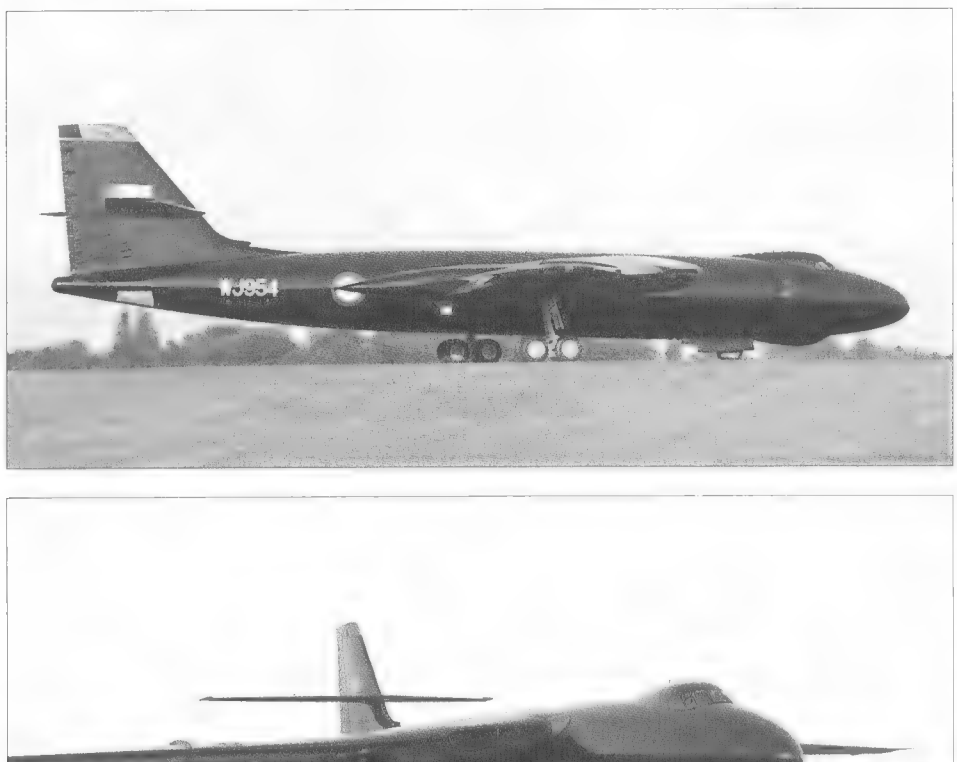
Opposite page, top: **Another splendid view of the one and only Valiant B Mk.2. The white patch is the aerial cover while the fairings used to house the new bogie main undercarriage can be seen aft of the wing trailing edge.**

Opposite page, bottom: **WJ954 painted all-black for night operations.**

was of course that the undercarriage was now housed in pods because all of the wing was used for fuel. Another change was a stretched nose – the main undercarriage with its four-wheel bogies was further aft than on the B Mk.1 so, to balance the change in CofG, the nose had to be stretched. In all the B Mk.2's fuselage was 4ft 6in (137cm) longer than the B Mk.1's.

Early performance tests with WJ954 showed it to be flutter-free up to 480 knots (889km/h) TAS and further flights were planned to take it up to approximately 520 knots (964km/h). Real fuselage vibration tests were carried out in the air on 23rd September and again on 7th October, while on 17th November buffet tests were made during a flight using just three engines. Progress was good enough for a high Mach number dive to be made on 16th December. The Valiant B Mk.2 was flown to a maximum Mach number of 0.905, the particular flight being made with a crew of two at an all-up weight of 110,000 lb (49,896kg). A dive was commenced at 46,000ft (14,021m) using full power on all engines and, according to photographic evidence, the peak was reached at 40,500ft (12,344m) in 25 seconds. This gave a rate-of-dive of approximately 8,000ft/min (2,438m/min).

WJ954 had been strengthened internally to enable it to fly at low altitude and it attained a speed of 552mph (888km/h) at low level where the B Mk.1 was limited to only 414mph (666km/h). By June 1954 the prototype had flown 70 flights and 74 flying hours, some of with instrumentation for in-flight resonance testing. It had also been used earlier in the year for an in-flight refuelling exercise on behalf of Flight Refuelling Ltd. A refuelling probe was fitted on the nose to make dry contacts with an English Electric Canberra, the idea being to sample the method at high speed and high altitude. Then in September WJ954 took part in the SBAC Farnborough Show where it was demonstrated in flypasts at 480 knots (889km/h) and, thanks to its all-black finish was dubbed the 'Black Bomber'. On 12th September the B Mk.2 prototype completed a high-speed stability test.



Two views of the prototype B Mk.2 in flight.

This shot illustrates well how the all-black livery hid most of the detail of this special low-level Valiant.

A rather imposing view of WJ954 on the ground.

Another job for the B Mk.2 was to help clea the Rocket Assisted Take-Off Gear (covered i Chapter 5). During the first flight with Supe Sprite rockets fitted, on 6th October 1954, th starboard external rocket nacelle broke awa forcing the pilot to jettison the port nacelle on Wisley airfield. Considerable damage was sus tained on both sides of the fuselage and to th starboard undercarriage nacelle; investiga tions confirmed that the rockets on both side had not released cleanly. Therefore mor thought had to be given to the suitability of th equipment, its parachute and the explosive bo attachment. During this incident, prior to land ing the aircraft, it had been found impossible t lower the starboard chassis using either th main or emergency system, so the extrem emergency system which employed explo sives in the locking mechanism had to be used. This had worked successfully and enabled th chassis to be lowered and safely locked; th cause of the failure in the main and first eme gency systems had been the rocket damage t the nacelle and chassis doors.

By this time WJ954 had flown 136hrs 5mi in 122 flights. After repair it returned to servic and began some low-speed braking trials o on 21st April 1955 a starboard chassis attac ment fitting failed which caused the chassis t collapse and severely damage the aircraft. Th failure was not due to fatigue – it was simply th side that had been damaged in the previo incident; however, the resultant damage to some time to repair. In April 1956 WJ954 wa being prepared for fuel system trials with nitr gen purging and pregassed fuel that were to made in conjunction with the RAF; by 10th M 1957 the aircraft had completed a total of 10 35mins of flying on this programme.

On 17th May 1958, dismantling of the s Valiant B Mk.2, WJ954, had begun at Wisley af 167hrs 35mins flying. On 2nd July its rema

were seen on the road to Foulness Island for breaking up. The 17 production Valiant B Mk.2s which were ordered, serials WZ389 to WZ405, were given the Type Number 718 by Vickers but, as we have seen, they were later cancelled and replaced by additional B Mk.1s. These low-level aeroplanes were to have been powered by Conway engines and capable of sustained flight at high speed at low level (at heights between 200ft and 2,500ft [61m and 762m]).

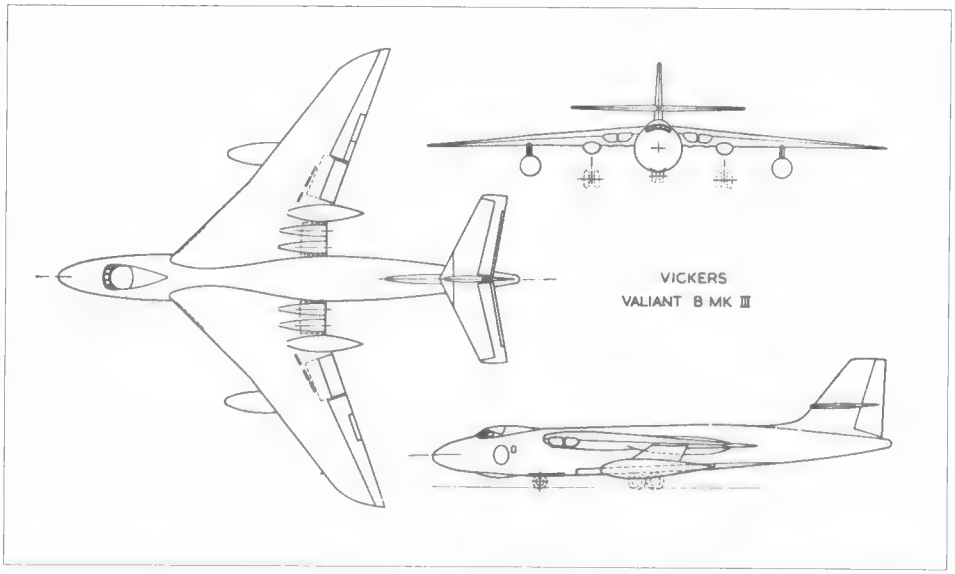
There were proposals for further Valiant developments which, sadly, never passed from the drawing board. They are, however, of great interest.

Valiant B Mk.III

In May 1952 Vickers prepared a brochure (No A.337) for a Valiant B Mk.III in bomber, PRU and pathfinder versions which was intended to be the replacement for the Valiant B Mks.1 and 2. The company numbered it Type 722 which indicates that Vickers thought this might be a serious proposition. The chosen engines were four 11,500 lb (51.1kN) Conways and Vickers noted that the project 'demands a wing with a high critical Mach number for the full cruising performance to be attained. A project whereby the outer wing sweepback is increased to 33° has been in being since early 1948'.

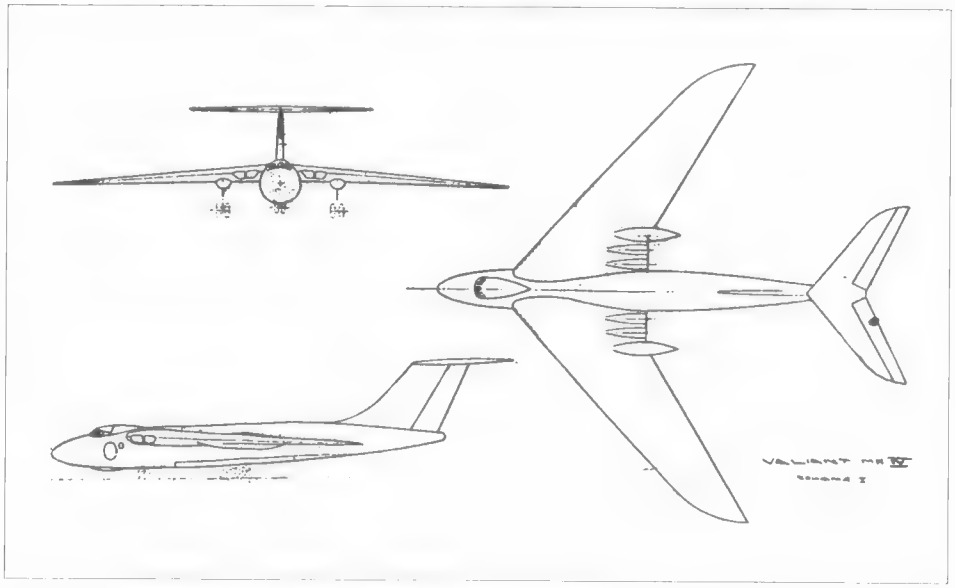
The Valiant B Mk.III was a standard Mk.1 with its normal wings replaced by examples given the higher sweep angle of 33°; essentially the standard wing's geometry had been pivoted around an additional 12° to push the sweep on the outer plane up to 33°. The chassis would be similar to that produced for the B Mk.2 and the aircraft was designed for a diving speed of 390 knots (723km/h) EAS. Estimated data follows:

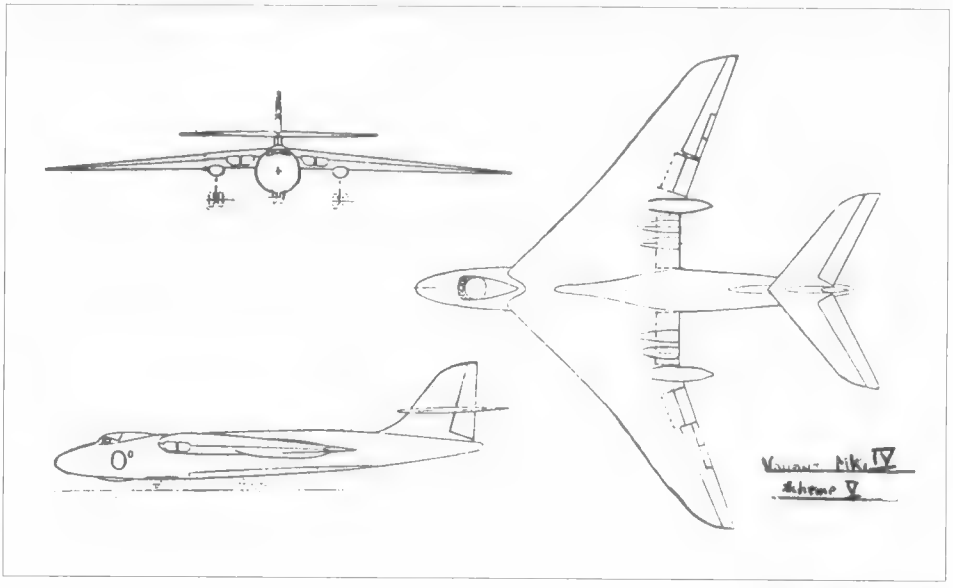
Dimensions		
Span	108ft 9in	33.1m
Length	108ft 2½in	33.0m
Height over fuselage	14ft 10in	4.5m
Track	28ft	8.5m
Wing	Vickers high speed aerofoil	
sweepback on 0.25 chord line		
at stations 0 to 92	36° 53'	
at stations 210 to 544	33° 10'	
Gross wing area	2,270ft²	211.1m²
Aspect ratio	5.2	
Weights		
Basic operational	78,176 lb	35,461kg
All-up weight	188,541 lb	85,522kg
(fuel would be given up for an increased bomb load)		
Performance		
Max speed at 124,200 lb (56,337kg) mean weight		
at sea level	435 knots	806km/h
at 10,000ft (3,048m)	472 knots	875km/h
at 20,000ft (6,096m)	535 knots	991km/h
at 40,000ft (12,192m)	504 knots	934km/h
Rate of climb		
at sea level	4,900ft/min	1,494m/min
at 30,000ft (9,144m)	2,640ft/min	805m/min
at 45,000ft (13,716m)	600ft/min	183m/min
Service ceiling	48,000ft	14,630m
Range with 10,000 lb (4,536kg) of bombs at 491 knots (910km/h)	6,440nm	11,933km
with 21,000 lb (9,526kg) bombs	5,650nm	10,469km
Range with 41,000 lb (18,598kg) of bombs at 453 knots (839km/h)	3,164nm	5,863km

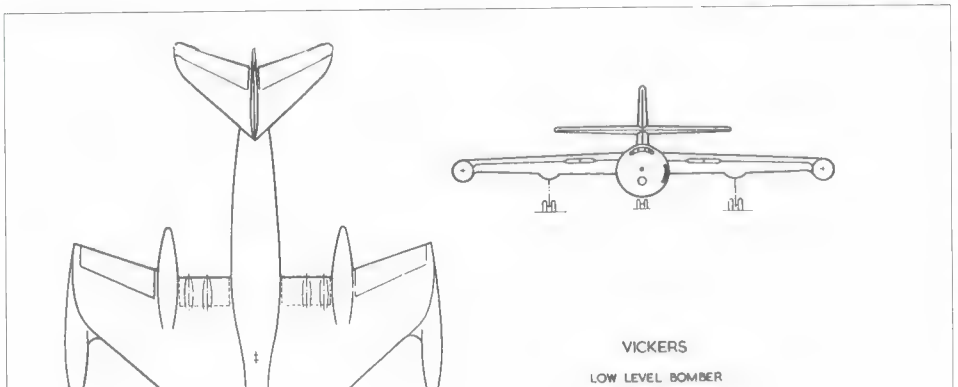


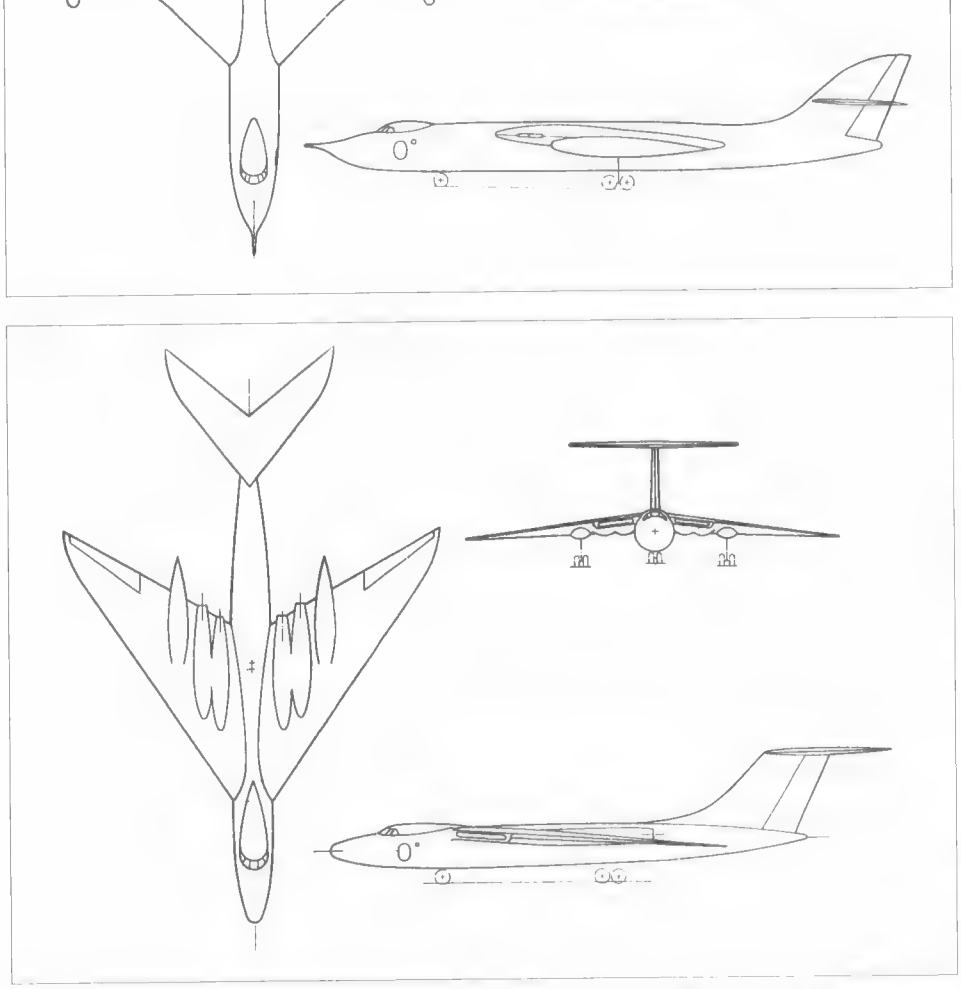
Above: **General arrangement of the Vickers Valiant B Mk.III proposal of May 1952.**

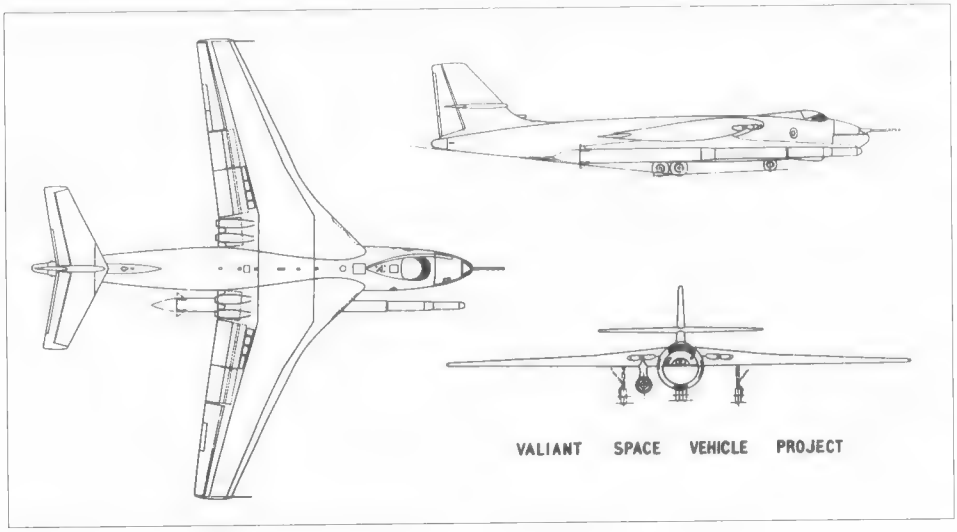
Below: **Schemes 1 and 5 in the series of designs prepared under the title Valiant Mk.IV.**











Valiant B Mk.IV

This mark was really just a continuation of the studies originating from the B Mk.2 and Mk.III which basically looked into different sweptback wing planforms. For the Mk.III Vickers had completed a full brochure but on the Mk.IV only scheme drawings were prepared; no Type number was allocated because no Works Orders were ever issued to the project. Basically it used the B Mk.2's fuselage and undercarriage and was sketched in at least six different forms (Schemes 1 to 6). The following information is believed to be all that now remains:

Scheme 1. Span 125ft (38.1m), wing area 2,905ft² (270.2m²), aspect ratio 5.37, speed 510 knots (945km/h), weight 50,000 lb (22,680kg). This design had a T-tail and was powered by four Bristol Olympus engines.

Scheme 4. Wing area 3,160ft² (293.9m²), aspect ratio 7.12, speed 510 knots (945km/h), weight 51,000 lb (23,134kg), four Bristol Olympus engines.

Scheme 5. Speed 491 knots (910km/h), weight 49,700 lb (22,544kg), four Bristol Conway engines. This project resembled the B Mk.2.

Scheme 6. Wing area 2,778ft² (258.4m²), aspect ratio 5.2, speed 507 knots (939km/h), weight 49,200 lb (22,317kg), four Bristol Olympus engines.

Low-Level and Supersonic Bombers

In July 1952 Vickers undertook a combined preliminary study into two further Valiant developments – a dedicated low-altitude bomber and a supersonic bomber. The former was based on the B Mk.2 but had modified main planes and could carry 10,000 lb (4,536kg) of bombs at Mach 0.85 for 4,300nm (7,964km). Cruise speed with drop tanks was estimated to be 521 knots (965km/h), without tanks 561 knots (1,049km/h). Span was 81ft 0in (24.7m), length 124ft 6in (37.9m), gross wing area 2,150ft² (200.0m²), aspect ratio 3.05, basic weight 99,200 lb (44,997kg) and maximum weight 306,000 lb (138,802kg).

The long-range high-altitude development was to be capable of sustained supersonic speed; with four reheated Conway 3s and a take-off weight of 177,000 lb (80,287kg) it could reach Mach 1.46 at 30,000ft (9,144m) and Mach 1.48 at 36,000ft (10,973m). Span was 85ft 0in (25.9m), length 130ft 0in (39.6m), gross wing area 2,000ft² (186.0m²) and basic weight 102,000 lb (46,267kg). Both projects were the result of informal discussions between Vickers and the Air Staff and represented preliminary examinations without any detail design.

Top: **Vickers low-level bomber project from July 1952 fitted with tip tanks.**

Centre: **Vickers supersonic high-altitude bomber project from July 1952**

Bottom: **In early 1950 Vickers put together the Valiant Space Vehicle concept which appears to have been intended to launch a large rocket while in flight. The idea was stillborn.**

Production and Early Service

B Mk.1 and B(PR) Mk.1

The first production order for 25 Valiant Mk.1s was issued under Contract Number 6/Aircraft/6313/CB.6(c). However, such was Vickers' workload that some of the major assemblies, including the crew pressure cabin allocated to Saunders-Roe at Cowes in the Isle of Wight, had to be sub-contracted out. In all, eight major sub-contractors eventually worked on the Valiant plus many ancillary firms.

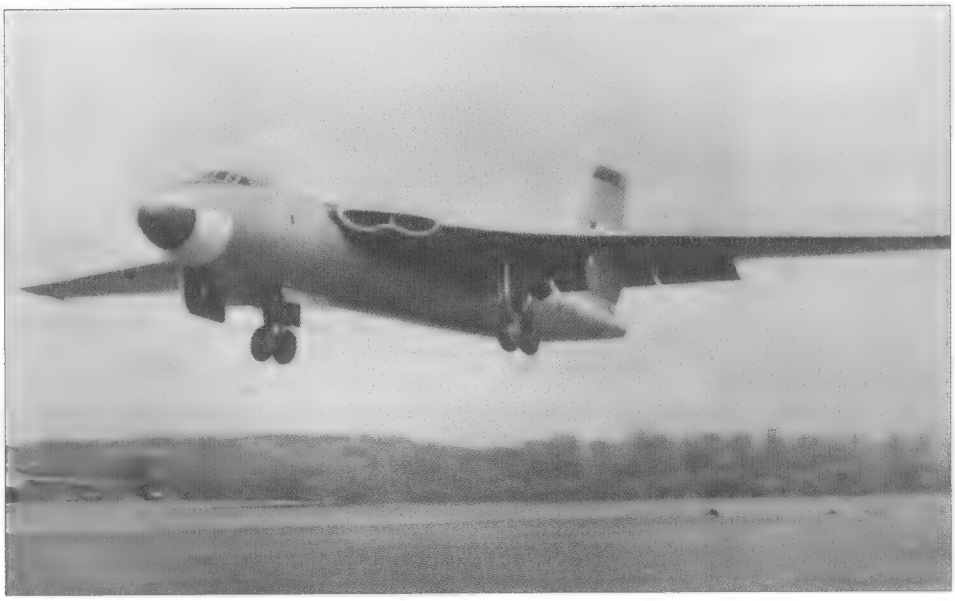
In addition, new production techniques had to evolve, heavier gauge materials had to be used and the quality of surface finish or smoothness was the order of the day. Power stretching and forming tools were used extensively for all of the Valiant's leading edges, fuselage panels, fuselage frames and spar sections while sculpture milling was used for the first time to enable Vickers to manufacture the centre-section spar web plates. Also, because of its strength and high dielectric capabilities, glass fibre was coming into use for radomes and aerial covers – this was really the start of the composite fibre construction revolution because the designers did not want the nose radar's signal strength to be absorbed too much by the radome. Vickers had to set up new specialist departments to cater for all of this new technology.

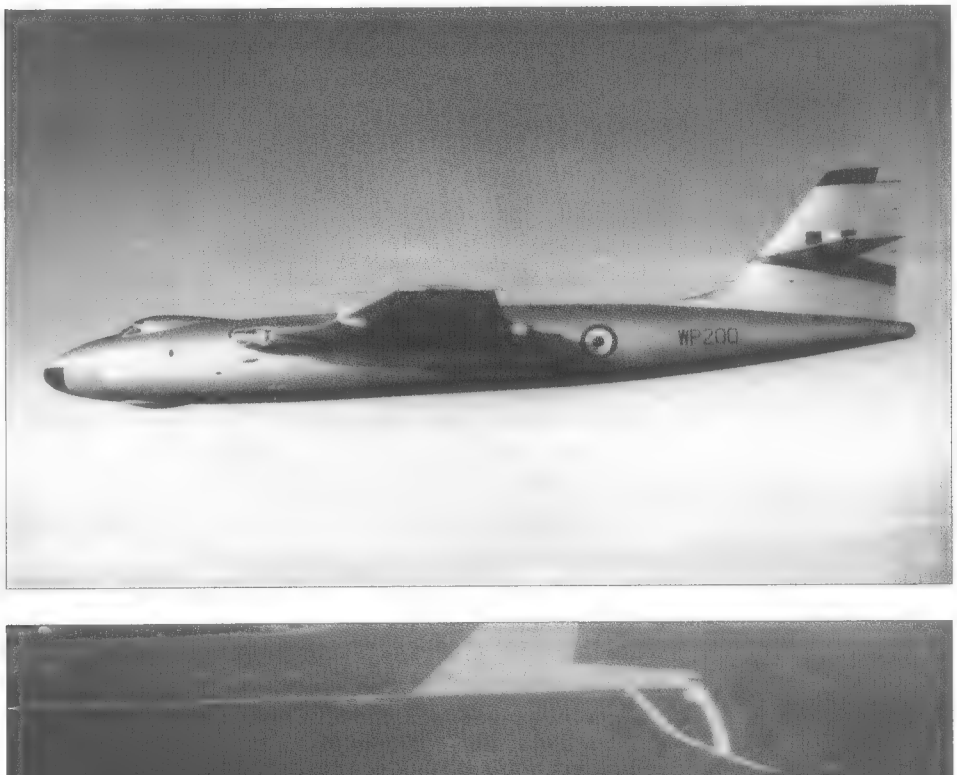
During World War Two, Barnes Wallis had designed the 12,000 lb (5,443kg) Tallboy and 22,000 lb (9,979kg) Grand Slam 'Earthquake' bombs and these were resurrected when in mid-1953 the Air Ministry asked the MoS to consider the possibility of carrying them on the Valiant, and indeed on the other V-Bombers as well. Talks with Vickers revealed that, using a modification kit that could be easily removed, it was possible to carry a Grand Slam in the Valiant and an order was placed on 8th March 1954 for enough kits to equip 48 aircraft. In contrast, in August 1953 the Air Ministry cancelled the requirement for any Valiant to carry Blue Boar.

During an aircraft's development, there can be many proposals for alterations and changes to its equipment and weapons; Valiant was no exception. In October 1953 the Air Ministry mentioned to Vickers that it wanted the Valiant's crew to be able to observe condensation trails. If the aircraft was flying at 45,000ft (13,716m), and vapour trails only appeared at around 35,000ft (10,668m), the aircrew should be able to see fighters or missiles approaching them from the ground. A month later the MoS disclosed that the underwing fuel tanks and the cocoons for carrying bombs on the Valiant, whose design had advanced very well, were not thought suitable for the Vulcan and Victor bombers. Also, early in the new year, the Air Ministry asked the MoS to investigate the possibility of the Valiant being able to carry Green Cheese, an anti-ship missile designed by Vickers and fitted with a Red Dean head and a Blue Boar body (Red Dean was a radar-guided air-to-air missile, Blue Boar a television-guided bomb).

After receiving R.A.14 engines, the second prototype began flying again in April 1953 and was used to clear fuel jettisoning and the carriage of drop tanks. However, not until the fuselage cracking problem had been solved was it allowed to fly to A&AEE to continue its full trials programme. Then, three days after arriving at Boscombe Down, another problem appeared. During a flight test on 11th July at high Mach numbers (a dive to Mach 0.9) severe buffeting was experienced which resulted in some structural damage to the wing together with a broken port undercarriage uplock. This was thought to be due to aileron flutter and WB215 returned to Wisley the following day for repairs; it flew back to Boscombe on 17th August.

WP199 was the first production Vickers Type 674 Valiant and made its maiden flight on 21st December 1953 from Wisley.





In the meantime the first production Valiant WP199, had flown on 21st December 1953. This aircraft now had extra mass balancing fitted to its ailerons with a view to effecting a cure but, during a dive test flight on 20th August, breakage occurred in the aileron linkage at roughly the same speed as the aforementioned flight in WB215. Two successful dives had been made at Mach 0.88 but on the third run, when WP199 entered its dive at Mach 0.84 at 45,000ft (13,716m), the aircraft suddenly dropped its starboard wing. Despite the application of opposite aileron the wing failed to pick up and the aircraft continued to roll over, went into a spiral dive and suffered severe buffeting. Recovery was eventually effected by both pilots applying rudder and easing the aircraft out of the dive, by which time both pitot heads had been seriously damaged and no flight instruments were working.

Fortunately, after it became apparent that aileron control had been lost, it was found that flying on the level was still possible. Directional control was obtained, with great difficulty, by yawing the machine and it was landed safely at Boscombe Down despite adverse weather conditions and no navigational aids or flight instruments. This was some achievement for the pilots concerned. The Air Ministry immediately clamped a grounding order on all Valiants and deliveries of production machines were halted pending an investigation into aileron failure. Examinations revealed that the aileron control rods had failed from overload while the flight test data showed that WP199 had dived to Mach 0.919, 0.922 and then 0.929, figures that were higher than intended. These troubles had ed all B Mk.1 flight development and testing armament and radar trials.

Before the type could fly again, strengthened aileron control rods had to be fitted to the entire Valiant fleet. WP200 was fully instrumented to measure aileron loads and, between 28th September and 2nd November 1955, carried out extensive flight trials but without achieving entirely satisfactory results. WP199 was cleared to fly but with maximum Mach number restricted to 0.86 while high-speed stalls were to be kept to a minimum because of the severe buffeting which occurred on the application of excess 'g' at high Mach numbers.

The development programme was appraised by the MoS in March 1954. Progress was described as slow and the manufacturer's flight test efforts 'seemed disjointed and there had been long periods of grounding'. The reason

Top and centre: **The second production machine, WP200, spent much of its life with RRE. The second view shows it in flight from the Radar Research Flying Unit (RRFU) at Pershore.** D Corley collection

Bottom: **On 14th March 1961 WP200 failed to complete its take-off from RRFU Pershore and was written off.** D Corley collection

for the latter included changing the engines from the R.A.7 to R.A.14, the loss of the first prototype, the undercarriage accident to the second prototype in October 1952 and the preparations for the New Zealand Air Race (in most cases hardly Vickers' fault). On the credit side take-off and climb, landing, general handling and three-engine take-off were all described as good, the type had been dived to Mach 0.90 without handling difficulties, the powered flying controls worked satisfactorily and manual reversion was acceptable for emergency use.

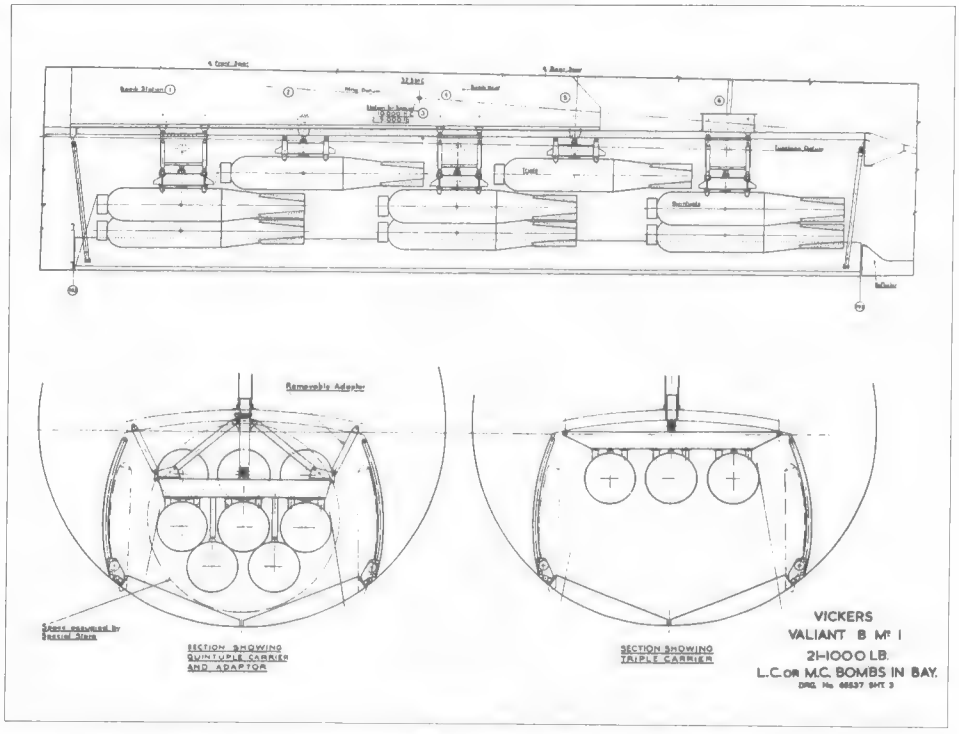
The first Consolidated Flight Test Report to be produced for the Valiant, dated 24th June 1954, revealed that a considerable amount of unserviceability had been experienced since the Avon R.A.14 had been installed. Out of the previous 24 weeks of test flying, at least eight were lost due to engine changes while serious delays were incurred waiting for replacement units, even though the faults were usually of a minor character. As a result the entry of the Valiant into RAF service was delayed. The introduction of the more powerful R.A.14 had caused some early fatigue failures in the rear fuselage at the junctions of the stringers and frames. The addition of cleats at these junctions, the deletion of indirect attachments and the fitting of convergent-divergent nozzles to the jet pipes brought these problems to an end. At the same time, intake buffeting had been experienced with both the R.A.7 and R.A.14 and this was cured by changing the profile of the intake lips and incorporating a 'T' splitter and partition slot.

Once these problems were sorted, the first six machines were accepted off production in December 1954 and allocated for trials, the first five for Controller (Aircraft) use. By 20th August 1955 12 production Valiants were being used for clearance testing and these had been assigned as follows:

WP199 had already been to A&AEE Boscombe Down for Handling Trials and CA Release. It had now returned for armament trials – the 100 lb (45kg) practice bomb had already been cleared and clearance of the Blue Danube nuclear weapon was expected by the end of the year.

WP200 went to the Royal Radar Establishment (RRE) for NBS development and clearance (it replaced one of the Shorts Sperrin prototypes initially intended for this work).

WP201 had initially gone to RAE Farnborough for armament trials; it was now at Wittering for Blue Danube development trials.



Top: **How 21 1,000 lb (454kg) bombs were loaded into the bomb bay of a Valiant B Mk.1. The Tallboy could also be carried but a Grand Slam needed special loading trolleys to get it to fit into this bay (Drawings of 65537 Sheet 3).**

Bottom: **The Valiant B Mk.1's wing bomb installation.**

WP202 was at A&AEE for radio clearance trials and CA Release.

WP203 following aileron tests at Vickers, went to RAE for bomb flying trials (on 20th August it was actually being repaired after a taxying accident).

WP204 had joined the Handling Squadron at Boscombe Down.

WP205 was the photo-reconnaissance trials aircraft.

WP208 having already been with 138 Squadron, was now at Vickers for an RAE programme to clear the autopilot.

WP209 was at Woomera in Australia for bomb ballistics trials.

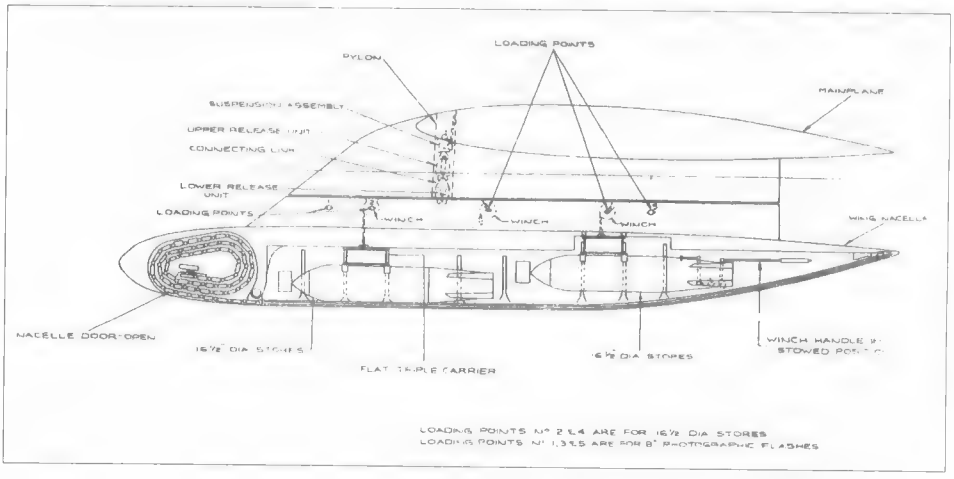
WP210 was being used by the manufacturer to establish the maximum Mach number for the type.

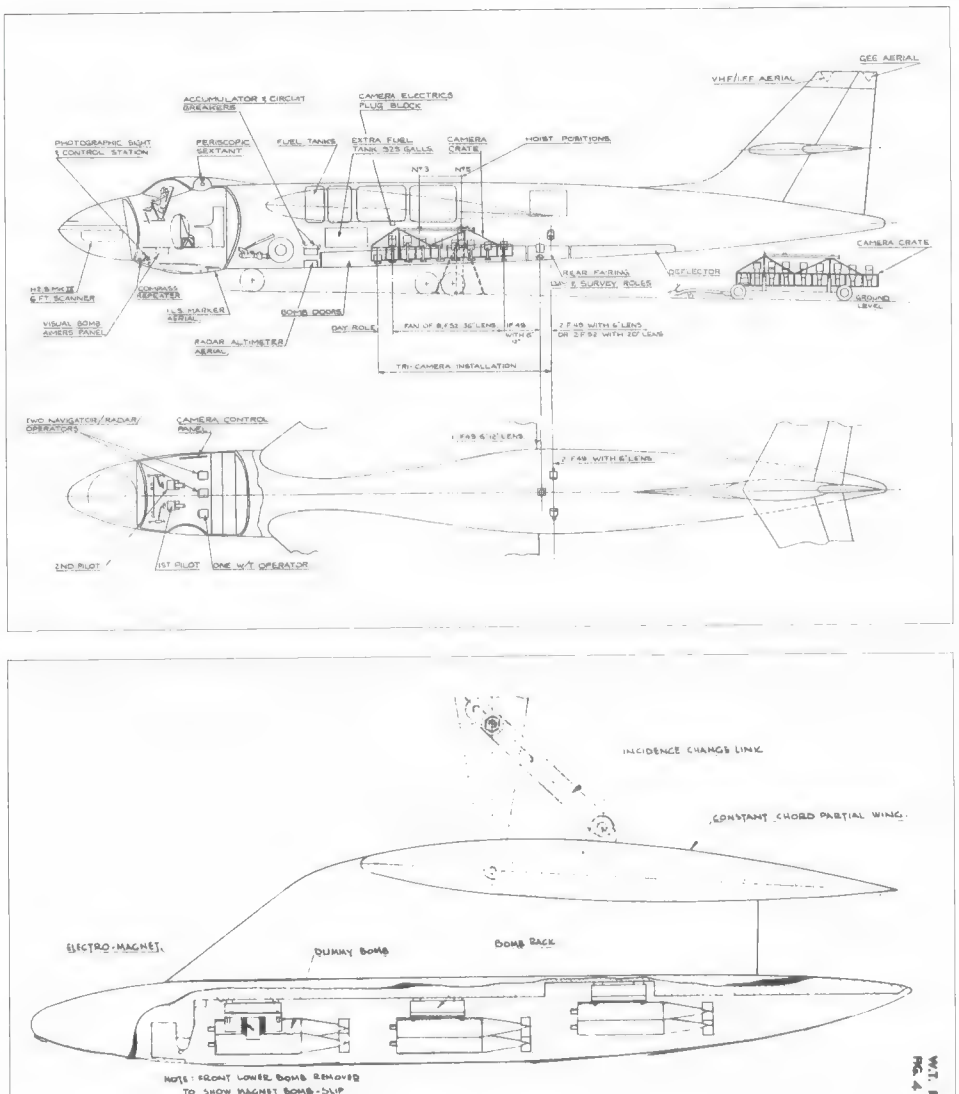
WP214 was at RAE Farnborough being fitted out for the Blue Study radar bombing system on which development trials were to be flown by A&AEE.

WP218 was at Vickers for engineering and performance development.

The Valiant's bomb load was impressive. Besides the bomb bay, which could take either one 10,000 lb (4,536kg) or up to 21 1,000 lb (454kg) bombs, the aircraft could also carry in special fairings or bomb nacelles (replacing the long-range tanks) a single 10,000 lb bomb on each wing or up to 12 1,000 lb bombs per wing. This could give a total bomb load for the Valiant B Mk.1, over short distances, of three 10,000 lb or 45 1,000 lb bombs. Instead of the bomb nacelles or panniers it was also possible to carry a 10,000 lb bomb on each underwing pylon using a special fairing. In 1956 the bomb panniers were still in the design stage while work was also proceeding on a suspension fitting to carry a single 22,000 lb (9,979kg) Grand Slam bomb. The bomb bay itself was 32ft (9.75m) long, 6ft (1.83m) wide and 5ft 6in (1.68m) deep. In August 1956 the bomb-carrying cocoons were cancelled and all work on them ceased.

The first photo-reconnaissance conversion of the Valiant was to be the seventh production aircraft, WP205. Despite OR.279 having been





The PRU conversion of Valiant B Mk.1 which was designated B(PR) Mk.1 (Drawing 65537 Sheet 1).

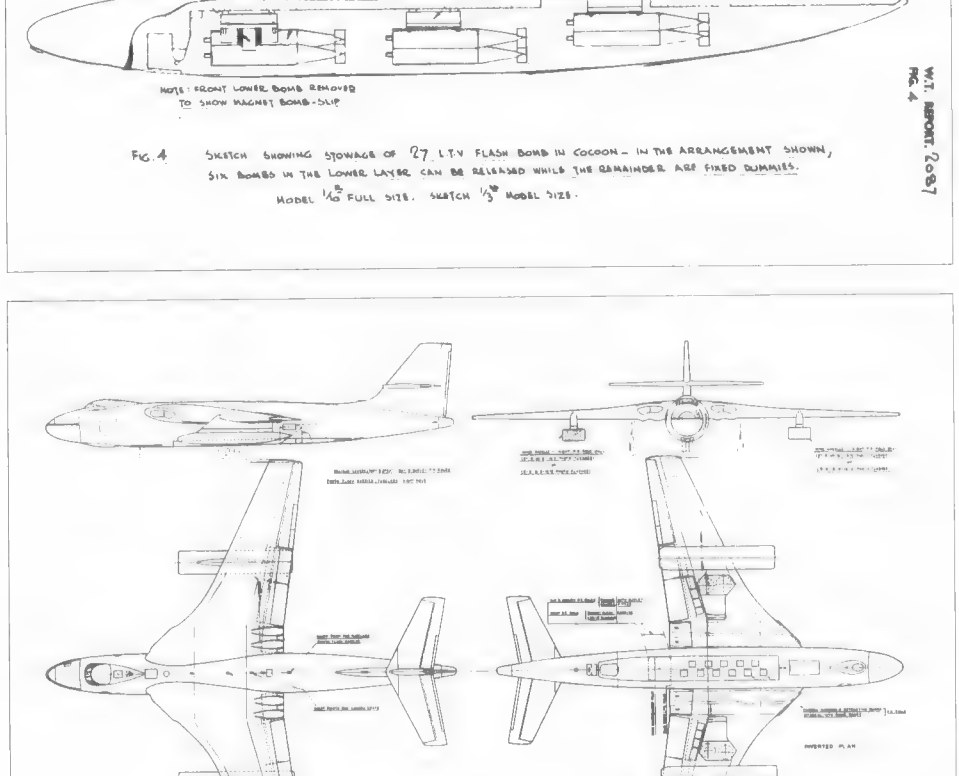
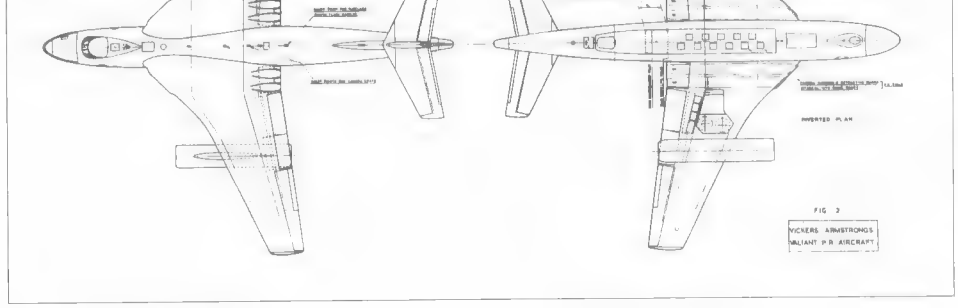


FIG. 4 SKETCH SHOWING STOWAGE OF 27 L.T.V FLASH BOMB IN COCOON - IN THE ARRANGEMENT SHOWN, SIX BOMBS IN THE LOWER LAYER CAN BE RELEASED WHILE THE REMAINDER ARE FIXED DUMMIES.
MODEL 1/10 FULL SIZE. SKETCH 1/3 MODEL SIZE.

Vickers 1/10th scale model wing cocoon loaded with 27 LTV photo flash bombs and tested in the wind tunnel in 1956 to check the characteristics of these stores when carried by the Valiant and released at speeds between 200 and 350 knots (371 and 649km/h) EAS.



The ultimate Valiant night role PR aircraft with the standard fuselage cameras and wing nacelles carrying 27 8ft (2.44m), or nine 8ft and three 16ft 6in (5.03m), photo flash bombs (dated 27th March 1955).

Photographs on the opposite page:

Top: **WP217 became the first Type 710 B(PR) Mk.1 following the prototype WP205 and is seen here taking part in the 1958 SBAC Farnborough Air Show.**

Bottom: **WZ396, a B(PR)K Mk.1, makes a demonstration pass with undercarriage and flaps down and with all ten camera port doors open.**

cancelled, Vickers still followed this document as closely as possible and the mock-up conference had been held at Weybridge on 5th November 1952. The conversion from bomber to PR involved installing a 525 gallon (2,387 lit) fuel tank in the forward end of the bomb bay and fitting two fuel bags to the two rear fuel tanks. The main cameras were carried in a crate structure in the bomb bay and there were three different types of 'crate': day role, night role and survey role.

WP205 was first flown in its PR configuration (known to Vickers as Type 710) on 28th June 1955 by B G Aston, with D J Davies as his co-pilot (it had first flown in B Mk.1 form the previous October and the Type 710 maiden flight had originally been scheduled for May). They flew for 40 minutes carrying out photographic runs at 240 knots (445km/h) over Wisley, Dunsfold and London. All eleven cameras were operated and the camera doors functioned correctly. The following day the same pair flew the aircraft to 40,000ft (12,192m) and Mach 0.84 cruise to measure the cameras' linear vibration; unfortunately the weather did not allow very many acceptable pictures to be taken.

The third flight, on 3rd July, lasted three hours and thirty minutes and camera vibration was measured up to a maximum height of 45,000ft (13,716m). On this flight No 2 camera jammed, the starboard camera window doors failed to close and the first pair of port door camera windows were found, after landing, to be covered with heavy condensation. WP205 was then flown to Boscombe Down on 14th July to undertake some night flights to determine camera angular vibration. Five flights were made, by the same crew, before the aircraft was flown to Idris in Libya on 15th September 1955 for tropical trials. The ground crew and equipment were transported there in an Avro York (serial MW234) and, during the trip, the Valiant also visited USAF Wheelus Field air base for further tests. It returned to the UK on 9th November.

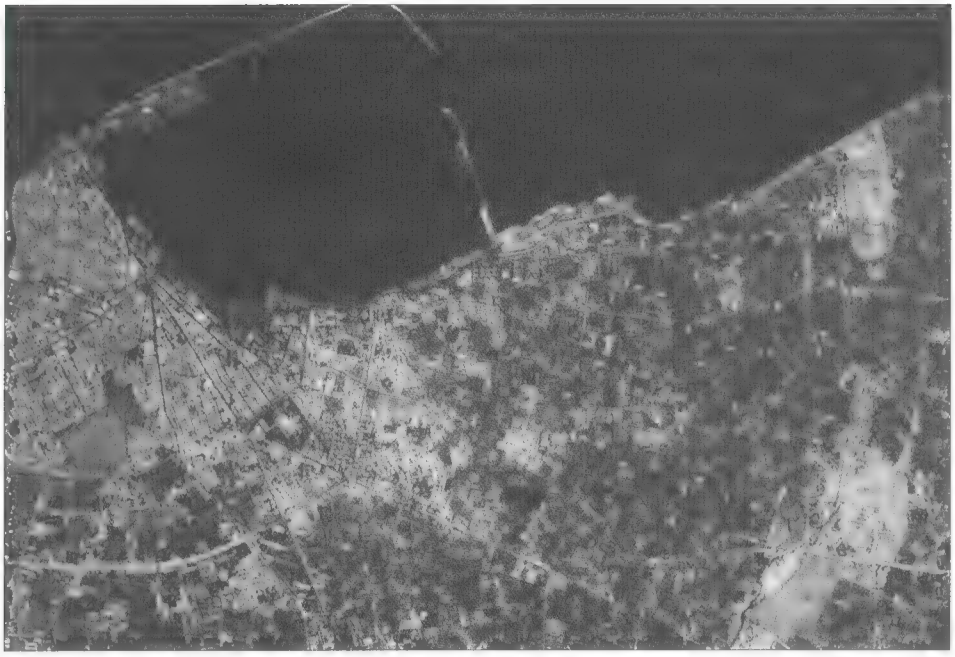
The final day role camera fit on WP205 was:

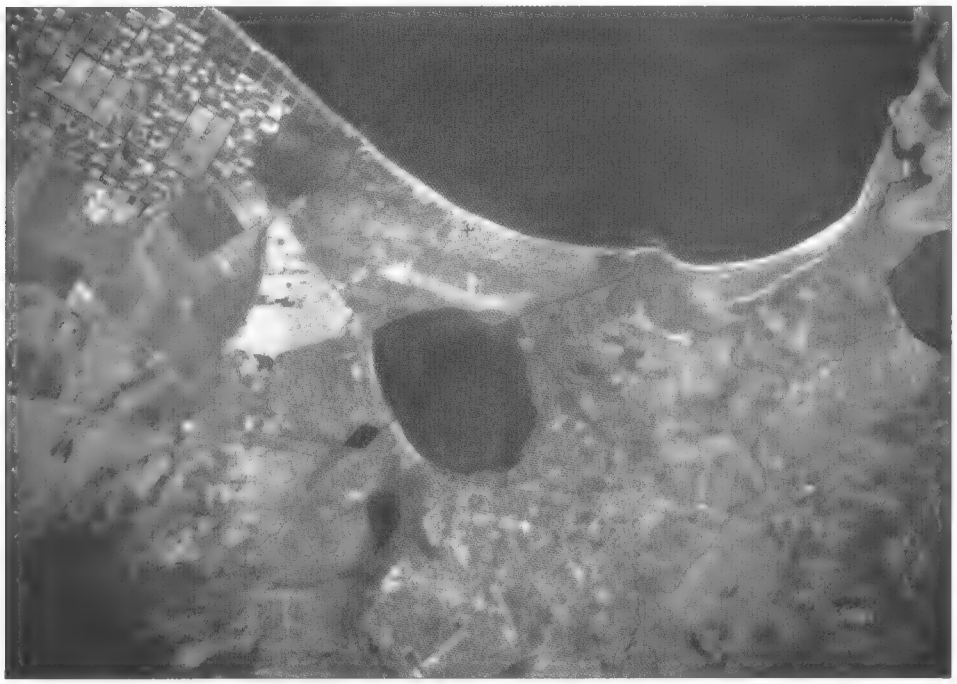
i. Eight F.52 cameras with 36in (91.4cm) lenses arranged to have three oblique to port, three oblique to starboard and two vertical;
ii. Three F.49s with 6in (15.2cm) lenses that constituted a 'tri-camera installation' for wide-angle coverage, one on the crate with the other two in the fuselage aft of the bomb bay;
iii. One F.49 camera fitted with either a 6in or 12in (30.5cm) lens and placed just aft of the camera crate on the fuselage floor.

The normal bomb doors were removed and replaced by the camera doors with electrically operated camera shutters and 11in by 18in (28.0cm by 45.7cm) sliding windows, six on the port side and five on the starboard side.

The following Valiants were also produced as B(PR) Mk.1s: WP217 (which first flew on 27th April 1955), WP219, WP221, WP223, WZ377 to WZ379, WZ381 and WZ383 to WZ384. The Air Ministry also requested that some Valiant flight refuelling tankers (designated B(K) Mk.1 and described in Chapter 5) should have a PR capability, as B(PR)K Mk.1s, and the first, WZ376, flew on 15th November 1955. It was to be followed by WZ380, WZ382 and WZ389 to WZ399.

The first RAF Squadron to form on the Valiant was No138 at Gaydon in Warwickshire during February 1955 under the command of Wg Cdr





Left: **A harbour in Africa taken from 50,000ft (15,240m) with an F.52 camera and 36in (91.4cm) lens.**

Below: **Another view taken from 44,000ft (13,411m) with an F.49 camera and 6in (15.2cm) lens.**

R G W Oakley DSO DFC AFC DFM, who had previously been Bomber Command's liaison officer at Weybridge. Gaydon had been out of use for some time but was reactivated and extensively rebuilt to prepare it for the arrival of the first of the V-Bombers. By 19th February this unit had received WP205, WP206 and WP208 but the next example, WP211, did not arrive until 16th April. By 7th June seven Valiants were on strength and production was running at three per month; by 20th August 32 aircraft had been completed.

The Valiant B Mk.1 received an initial Controller (Aircraft) release for operation service in Britain and overseas in January 1955, subject to speed and manoeuvring limitations. As yet, there was no clearance for the carriage or release of armament stores, autopilot, anti-icing or NBS. In the following June, Gaydon became 232 Operational Conversion Unit (OCU) to train crews for the type and to undertake intensive flying trials and RAF Wittering was selected to become the first airfield to receive an operational squadron. One of the first problems with RAF aircraft was some fires in the engines which were traced to the 'rubbing' of a seal in the engine compressor. The seal was modified by Rolls-Royce and extra fire warning fitted. In May the speed and manoeuvre limitations were eased, the carriage and release of practice bombs authorised and the HF radio and Green Satin doppler navigation system were fully cleared.

Another early setback occurred on 29th July when 138 Squadron's WP222 crashed at Wittering after a normal take-off. The aircraft had turned to port and continued to bank when the nose began to drop and the angle of bank reached 60°. The crew door was opened for an emergency exit and the air signaller jumped out of the aircraft (but was killed after hitting it) while the rest of the crew died in the ensuing crash near Wittering. They were Sqn Ldr E R Chalk AFC (pilot), Flt Lt A G Allen, Flg Off T S Corkill and Plt Off A R Lyons. The cause was found to be a runaway trim actuator that had run the tab fully up, the subsequent force that this generated being too great for the pilots to control. As a result a limit was placed on the trim tab's movement so that pilots could overcome the control forces even at full speed.

The first production Valiant B Mk.1s were fitted with 9,500 lb (42.2kN) Avon R.A.14s and lengthened jet pipes and had dielectric scanner cupolas covering the H2S Mk.9 radar and Navigation Bombing System (which in fact was not to be fitted for some time); this radar was much bigger and more powerful than the earlier wartime versions. A meeting held at the MoS on 19th January 1954 had discussed what engines were to be fitted in production Valiants the Air Ministry wanted to keep the water methanol arrangement so the decision automatically came down to the Avon. It was agreed that the Avon Mk.205 (R.A.28) would replace the Mk.204 (R.A.14) as soon as possible and was to be available to fit into the 38th airframe onwards.

To allow the manufacturing process to be completed quickly the aircraft's structure was fairly conventional, both in method and materials. The five crew were housed in a single pressurised compartment which formed the fuselage between the nose and wing. Behind this were two cross-beams that supported the fuel tanks above and the large bomb bay below while also linking the two wide-spaced main wing spars. The rear fuselage did not require immensely strong light alloy components and so was built with a semi-monocoque structure with the tail placed far enough up the fin to keep it clear of the jet efflux. In the wing roots, in fire-proof bays between the spars, were housed the engines while outboard came the Vickers-designed main gears which were built by Dowty-Rotol. Further out the space between the spars was filled by fuel and an external tank was carried beneath each wing at about mid-span.

The wing leading edge was fixed, the trailing edge had large ailerons outboard and double-slotted flaps inboard. The reduced sweep outboard was intended to prevent tip stalling with the greater sweep angle of the inner wing was needed to offset the loss of the benefits of using a swept wing experienced at the wing/body intersection. In addition the higher inner wing

Right: **A view of WP201, the third production Valiant.**

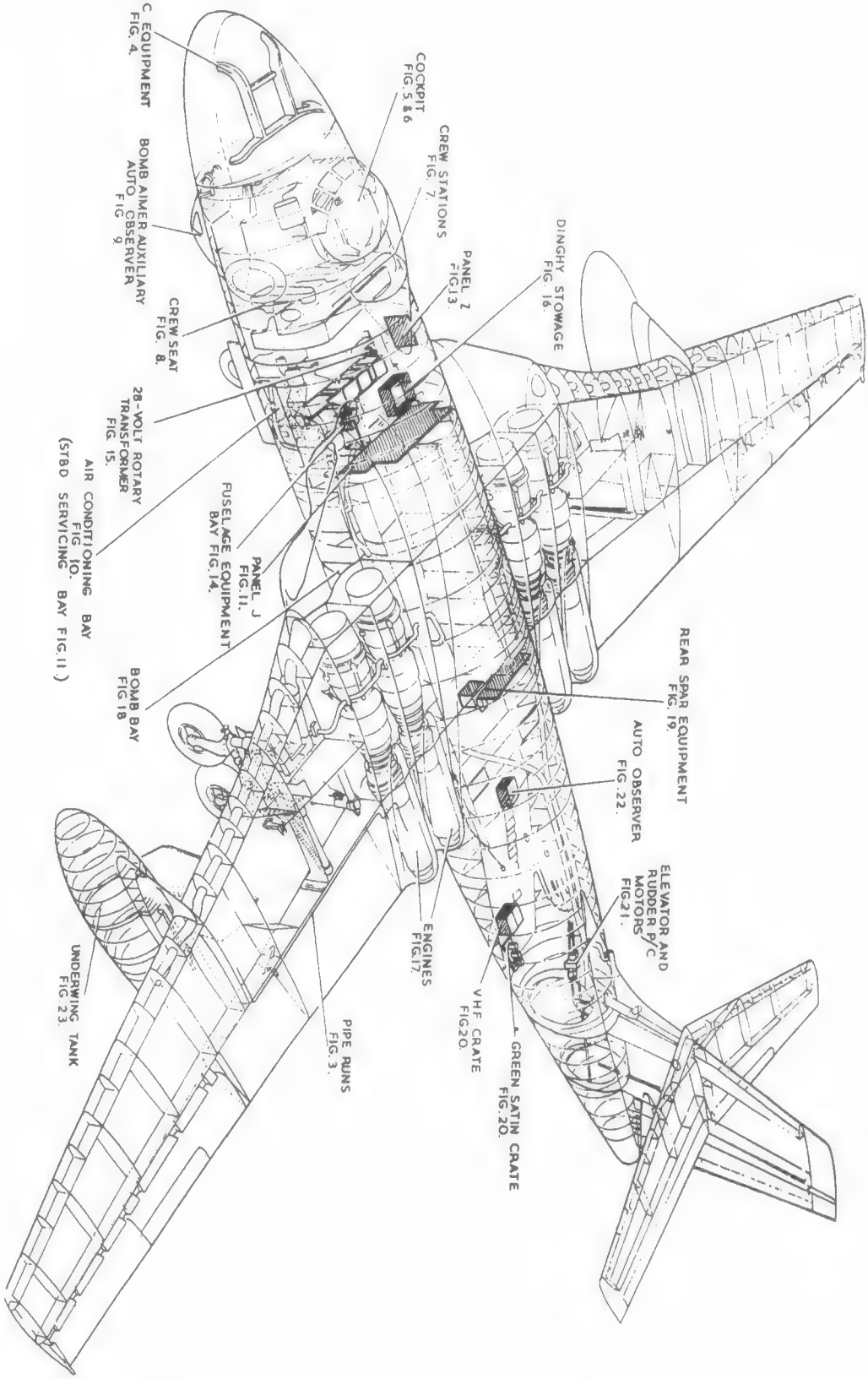
Below: **WP212 first flew on 14th March 1955 and was to serve with 138, 214, 199 and 18 Squadrons, and also 232 OCU, before final break-up in April 1965.**

sweep angle restored the overall balance of the wing sweep from root to tip, a concept invented and patented by Vickers' Aerodynamics Designer Elfyn Richards.

In July 1955 the Air Ministry was able to clear the Valiant for night flying while in September 138 Squadron put 12 aircraft into the air as part of the RAF flypast at Farnborough. This was the first public performance of the type in strength and the aircraft flew in pairs past the stand in a very impressive display that made everyone who was there proud to be British, while also announcing to the world that the RAF had a force to be reckoned with. By August some trials with vortex generators fitted to the top and bottom of each wing over the span of the ailerons had shown that the Valiant could be flown at Mach 0.9 while at the same time applying 1.0 excess 'g'; at the time the RAF was restricted to Mach 0.82.

In October a further study was made into the effects of vortex generators. Vickers had found that these were very effective in reducing buffet and flights had been made with design excess 'g' applied up to Mach 0.915, and in steady dives up to Mach 0.928. The company had discovered, however, that the penalty for using them was an 8% loss in performance. This new programme was intended to reduce the number of vortex generators and find a compromise between the reduction of buffet and loss in performance. Prototype WB215 flew the first test flight (to check the tail vortex generators) on 8th November; WP210 made the next trip on 14th February 1956 to check the flight limits for the wing vortex generators. By late February 1956 studies were also under way to get the Valiant to carry the Red Beard tactical nuclear store and the new Blue Steel all-weather stand-off nuclear bomb to OR.1132.

A total of 104 production Valiants were eventually completed, all of them built at Weybridge and, from the sixth example onwards, on or ahead of schedule. In addition, all of them were flown out off the 1,200 yard (1,097m) runway at Brooklands; indeed Vickers' test pilots even landed four examples on this short runway. Production peaked at four per month, the first delivery was made to the RAF in January 1955 and the last (XD875) in September 1957. For Vickers this was a remarkable achievement and a tribute to its design and production staff.



A Vickers cutaway drawing outlining the arrangement of the aircraft's instrumentation.

Testing, Testing

RATOG, Flight Refuelling, Counter Measures and Ejection Seats

Getting the Valiant fully operational involved several major research and development programmes, four of which are highlighted here. All have been mentioned briefly in the earlier chapters.

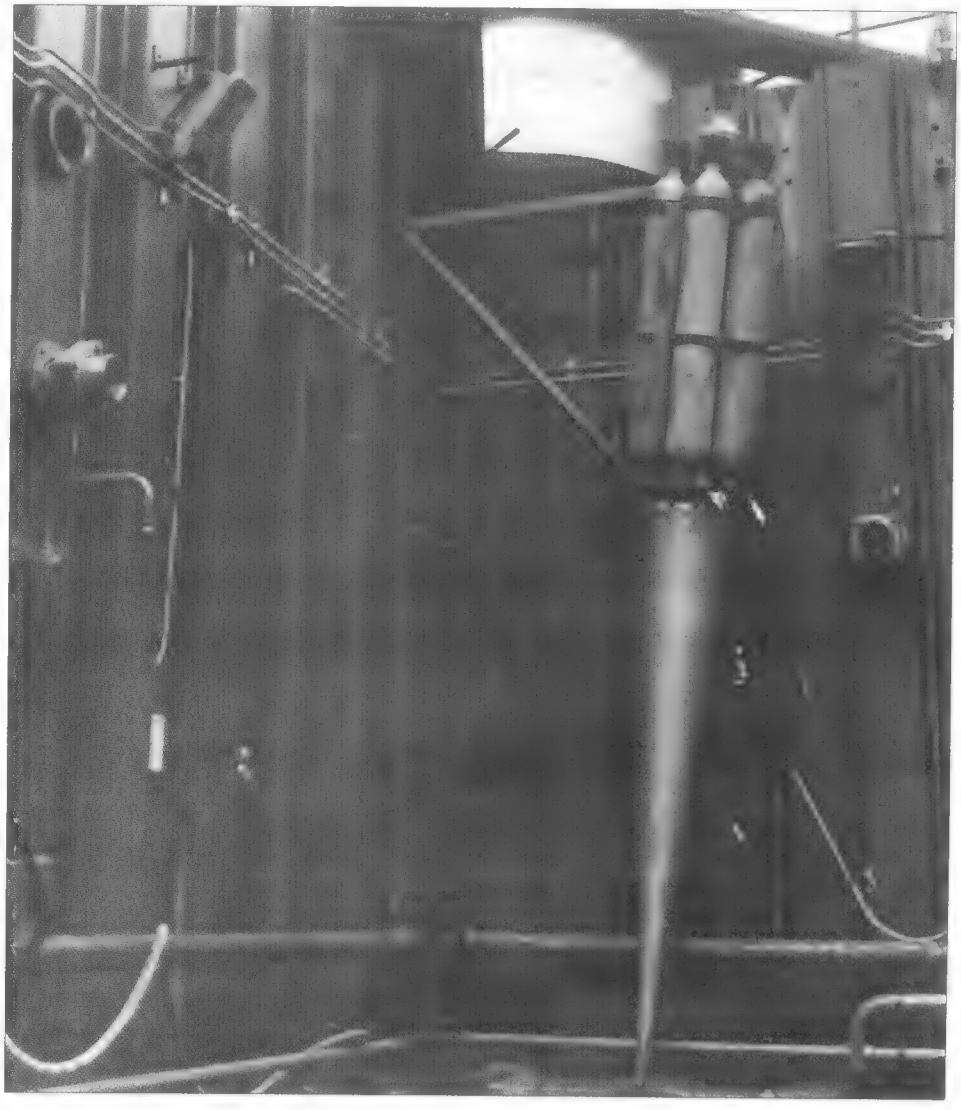
Rocket Assisted Take-off

The Air Ministry required that the Valiant should be able to take off in less than 2,000 yards (1,829m) when fully loaded at 160,000 lb (72.576kg), especially from airfields at high altitudes. Rolls-Royce had introduced water methanol into its Avon engines and this was helping to some extent. However, jet-powered aircraft were more sensitive than their piston-engined equivalents to the high ambient temperatures experienced in many countries and any loss of power would handicap the larger jet types, especially when taking off from small airfields.

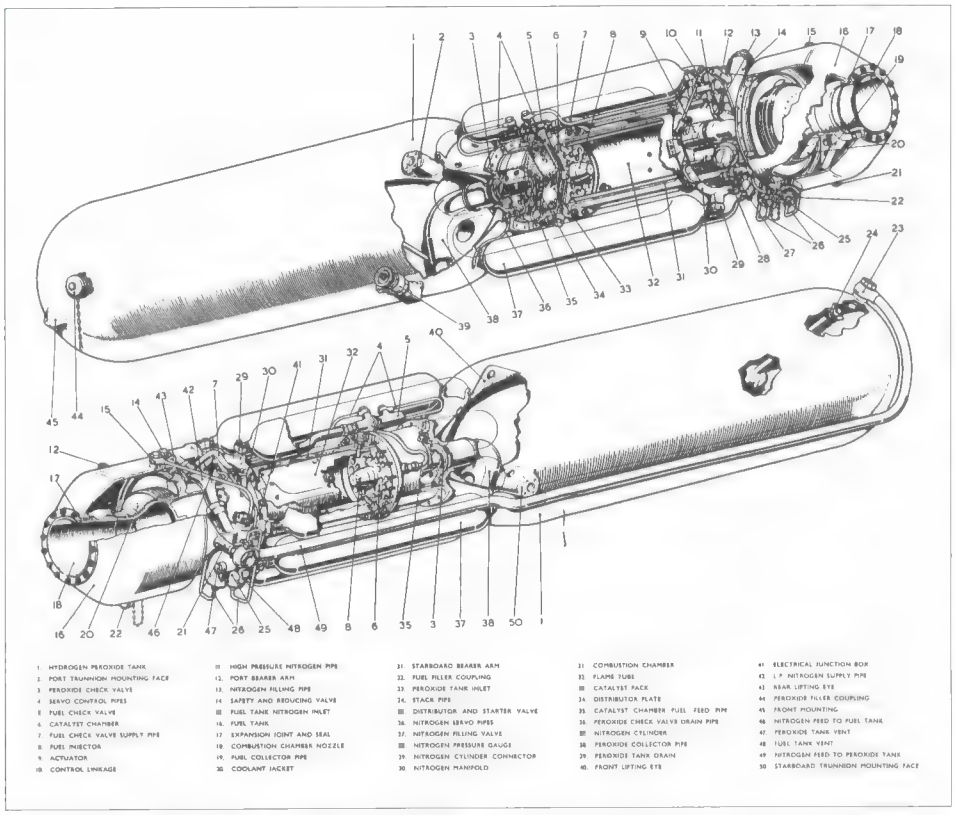
Rocket Assisted Take-off Gear (RATOG) had been studied in 1951 and the initial idea had been to obtain extra thrust from 14 small solid-fuel rockets in two clusters of seven, one mounted on each side of the fuselage. The Armstrong-Siddeley Scarab was designed to give 3,000 lb (13.3kN) of thrust for six seconds at 15°C, therefore each cluster would give 21,000 lb (93.3kN) to either side of the aircraft. At a meeting between RAE, RPD and Vickers on 19th May 1952, it was decided to conduct a trial at RPD Westcott on this type of installation against the rear section of a Vickers Valetta fuselage; it was important to find out if the rocket exhaust damaged the aircraft skin in any way. During a pair of tests conducted on 10th and 30th September 1952, one rocket burst after four seconds but the skin temperature did not go above 60°C, which was fine.

However, the Air Ministry was rather cold to this arrangement favouring instead a liquid-fuel rocket, but de Havilland had produced an alternative in the form of the Super Sprite. De Havilland's brochure noted that 'a rocket engine having a small size and low weight is unaffected by high altitude or ambient temperature conditions and so is the ideal solution to supplying the extra power needed to take off from a short runway when the temperature is high or the runway is too short. It is built into a self-contained unit which can be either permanently installed in the aircraft or jettisoned after take-off. The unit is compact and very powerful, using hydrogen peroxide and kerosene for propellants in conjunction with a solid catalyst pack of many layers of fine meshed nickel gauges plated with silver.' In January 1955 it became the first British rocket engine to secure Government Type Approval.

This motor gave a total impulse power of 120,000 lb/sec (54,432kg/sec) with a normal thrust of 4,200 lb (1,905kg) and could be used for a duration of 40 seconds; to suit different installations, both the maximum thrust and the total firing time could be adjusted within certain limits. This unit was very versatile and could be shut down at any time just by turning a switch. It was 9ft 9in (298cm) long and had an overall diameter of 20.25in (51.4cm); weight when empty was 620 lb (281kg), when fully fuelled the figure was 1,460 lb (662kg). Its fuel supply comprised 57gals (259.2 lit) of hydrogen peroxide and 5gals (22.7 lit) of kerosene and the unit could be used again almost immediately after a firing subject to refuelling or topping up. Once the aircraft had released a nacelle it would descend to earth using a parachute housed in the nose; the release itself could be made over a wide range of speed and height. After 50 firings the rocket would need an overhaul.



Taken at the RAE Westcott experimental rocket establishment, this photograph shows an Armstrong-Siddeley Scarab 'cluster' attached to a test frame with their exhausts ready to fire over a portion of fuselage from a Vickers Valetta (seen just above). The seven-rocket stick was made up of six in a circle plus one in the centre.



The venerable second Valiant prototype, WB215, went to de Havilland Hatfield in mid-January 1956 to have a Super Sprite installation fitted (following the installation aboard B Mk.2 WJ954 15 months earlier). On 22nd March there was an inadvertent release of the starboard Super Sprite when the aircraft was flying from Boscombe Down. This could have been a real disaster so the aircraft was 'frozen' under the same conditions to those when the drop occurred and the investigation found that the insulation on a cocking light switch had broken down. Rocket jettison trials were successfully completed by 27th March and in June the Valiant was test flown for the first time with the Super Sprites operating at full power; this too was successful. Further trials measured the minimum distance in which a take-off could be achieved and the difference made to the take-off run by variations in all-up-weight.

WB215 went to Boscombe Down on 24th September 1956 for trials, back to Wisley on 9th November for checks, to Boscombe again on 17th January 1957 before returning to Wisley, and then back to Boscombe again on 23rd March for the final clearance of the Super Sprite RATOG system. The aircraft took off on 29th April 1957 with Flt Lt R Bray as pilot, Flt Lt M J Cottee RAAF as co-pilot and S J W Brown from A&AEE's scientific staff as observer. After a measured take-off, a simulated engine failure was initiated but a loud bang was heard which shook the aircraft.

A Gloster Meteor flown by Flt Lt D Cartlidge was called up to look for damage and reported that a large piece of wing skin appeared to have come loose, but the aircraft behaved normally and the pilot then jettisoned the fuel and landed safely back at Boscombe. A ground inspection showed that one side of the rear wing spar had cracked near the wheel well; the results of this could have been a lot worse. This crack was attributed to the heavy handling and RATOG trials that the aircraft had received, including severe buffeting, throughout its test career. It appears WB215 did not fly again (total flying time was 489 hours) but it was reported at South Marston in December 1957 being broken up for test purposes. The fuselage was also reported on 4th March 1962 being taken by road to Foulness Island for breaking-up or for target practice.

That is, however, still not the last that we hear of WB215 because its starboard inner wing was fitted to a dummy fuselage, extending from the leading edge to the trailing edge, to represent an aircraft at dispersal. This was then used as a RATOG test-bed to simulate take-offs and landings and to allow the rocket unit to rest for up to 30 days before a test run. The idea was to establish if the Valiant's RATOG installation would stay fully serviceable throughout a 30-day period and also to determine the minimum servicing that was necessary to ensure reliable functioning.

Top: **Cutaway drawing of the de Havilland Super Sprite unit used on the Valiant.**

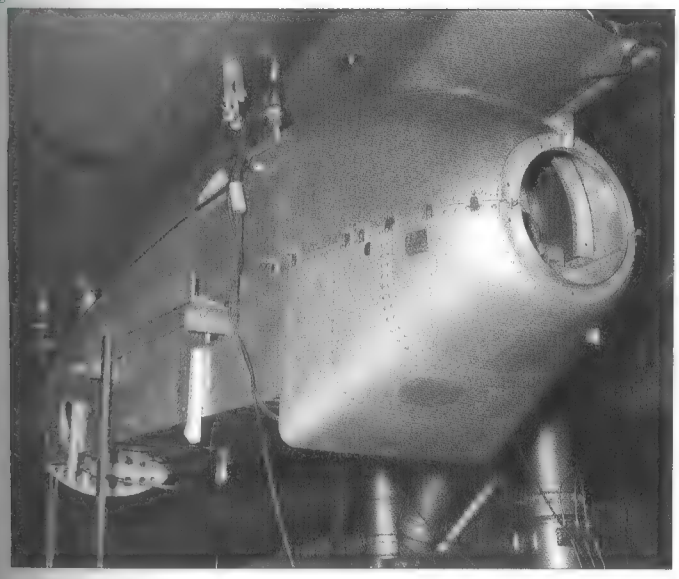
Left: **The rear end of a twin Super Sprite installation fitted to the Valiant.**

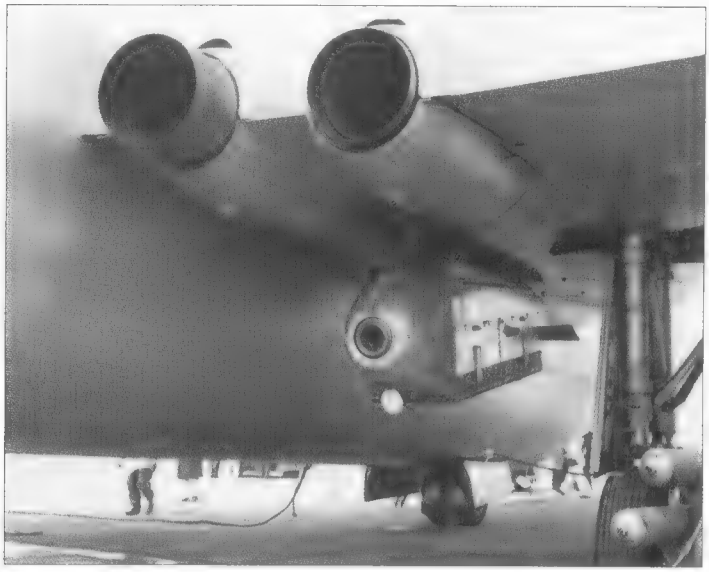
Photographs on the opposite page:

Top left: **Close-up of a Super Sprite partially installed.**

Top right: **The Super Sprite installation on the Valiant. Just to the right of the undercarriage can be seen the mobile refuelling trolley carrying hydrogen peroxide and nitrogen under pressure. There was one trolley per undercarriage and the final loading operation was to pressurise the nitrogen system.**

WB215's Super Sprites being given a trial run. Vortex generators can also be seen on the aircraft's fin.





The rocket unit was installed under the wing on 28th August 1959 at South Marston and the first 30-day period commenced on 1st September. Two 30-day stand-by periods were completed and throughout both the firing and release unit cocking circuits continued to function satisfactorily. At the termination of the stand-by period the Super Sprite unit was satisfactorily released, initially with the normal release system and finally by using the emergency release system.

Tropical trials of the Super Sprite began at RAF Idris on 11th July 1957. XD872 was the Valiant chosen for the programme and, immediately after the installation was fitted, a 48-hour pressurised stand-by was commenced using the starboard rockets only; on completion the Sprite was successfully fired. However, once take-offs were commenced it was found that both Super Sprites and water methanol were needed together; water methanol alone only lasted for 43 seconds which was not really long enough for worldwide service use. At a Valiant development meeting on 4th March 1958 the Air Staff stated that it wanted 39 Valiants to receive RATOG (up to now only two aircraft had been so fitted) and 40 aircraft were to have water methanol (this figure was later amended to 20).

The water methanol injection system was designed to restore engine thrust when taking off from high-altitude airfields or in high ambient temperatures and involved the injection of a mixture of these liquids into the combustion chamber. The water restored the mass flow through the engine and helped to cool parts in the hot end of the engine while the methanol acted as extra fuel. It was very efficient and provided a substantial restoration of power but the mixture was corrosive and poisonous.

During August 1958 the Super Sprite was tested by the Bomber Command Development Unit (BCDU) at RAF Wittering. Flight trials began with two ballasted units on the 19th and 21st and were followed by flights with two proper rockets on the 22nd, 25th and 26th. Only the last flight was perfect with no damage to the parachute or parachute lines. The next test was to fly long-distance ferry flights with the rockets *in situ*; the first was made on the 25th and comprised a flight of 1hr 15mins at high altitude at Mach 0.78 and 290 knots (537km/h) EAS and the following day another of 3hrs 10mins was made at Mach 0.81 and 280 knots

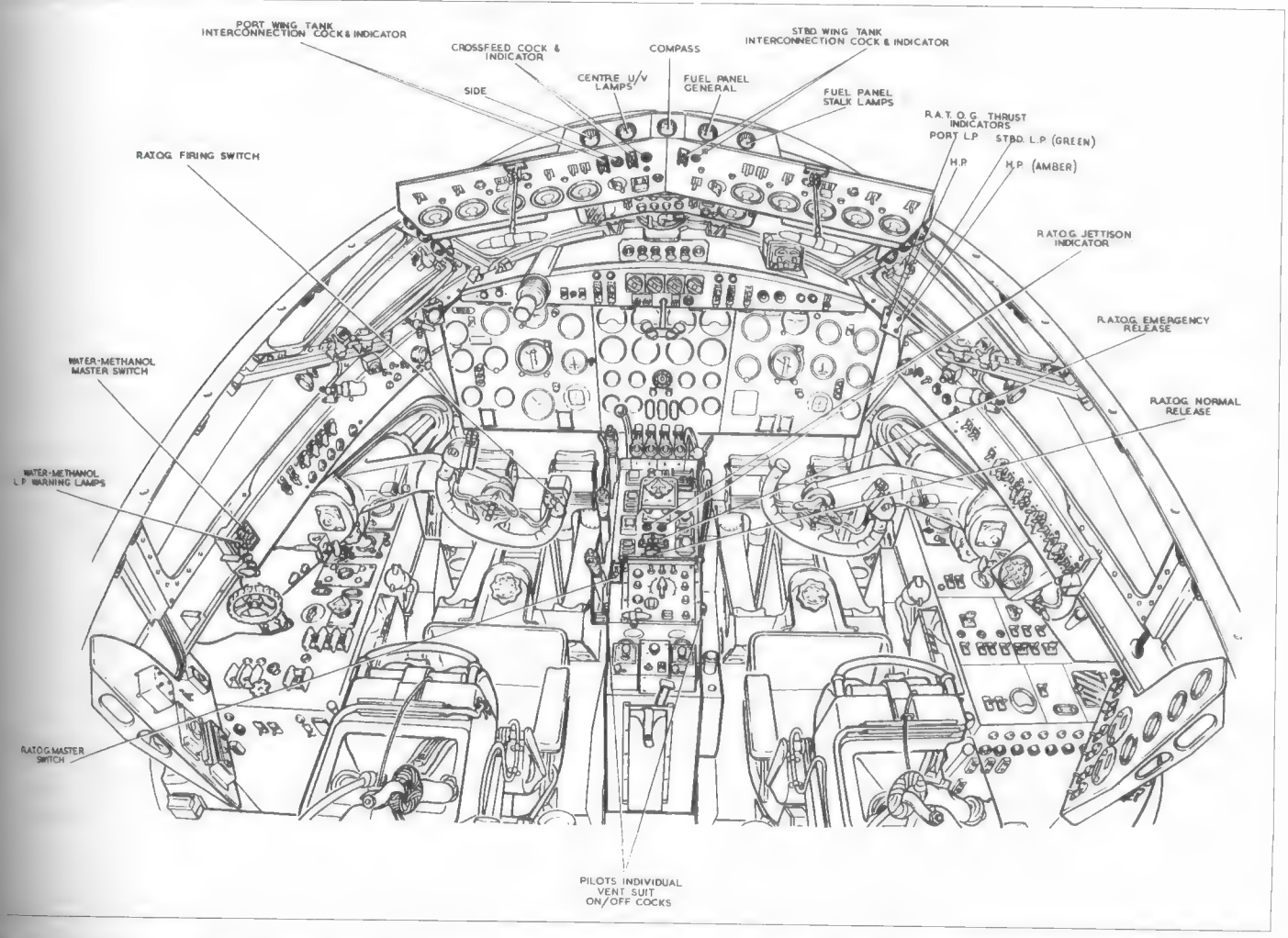
Above: **WB215 takes off from Farnborough aided by its rockets which leave plumes of smoke in their wake. Once they were exhausted, the rockets were jettisoned and retrieved on the ground, ready to be fitted and refuelled for another take-off.**

Left: **An excellent view of WB215 with the twin rocket packs helping to get it airborne.**

Photographs on the opposite page:

Top: **Drawing of the water methanol and RATOG installation switches in the Valiant cockpit. It must have been confusing to have so many switches and controls dotted around the instrument panel for operation only during take-offs.**

Bottom: **The inner wing (from WB215) and fuselage test frame for the 30-day Super Sprite stand-by test.**

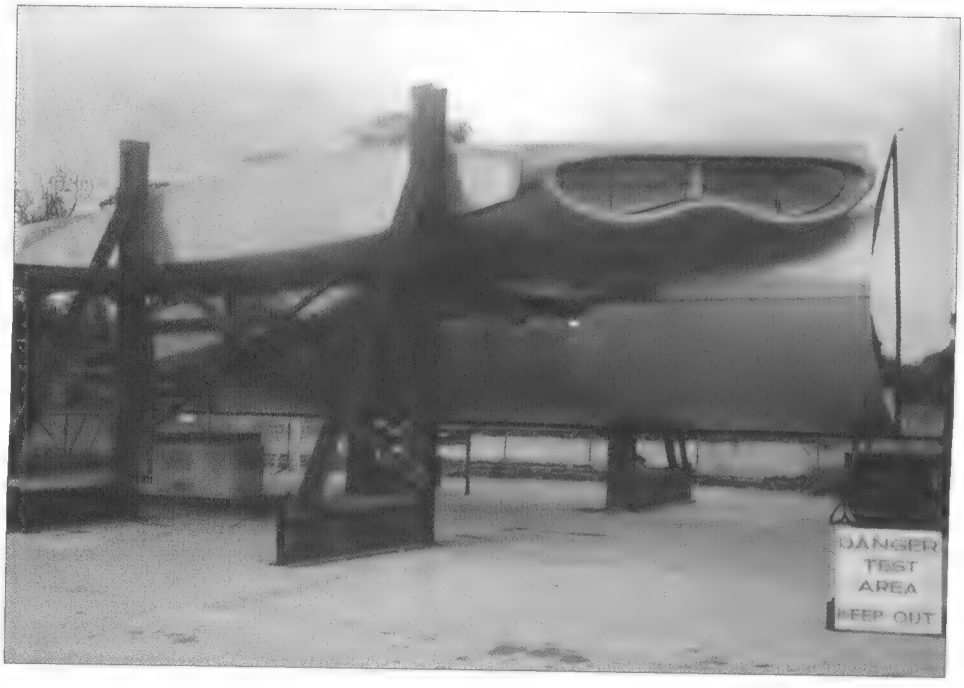


(519km/h) EAS. However, there were some problems with the parachute which in October forced the Air Ministry to put a temporary stop to the trials. The problem was sorted by the C Q Parachute Company who changed the position of the de-reefer, after which the trials were cleared to continue.

Valiant XD872 was also used in these trials and on 12th November 1958, during a take-off, the port unit fired and was released satisfactorily but the starboard unit failed to fire and on release landed heavily and suffered considerable damage; the cause was a bad contact on the fuel pump valve actuator. In the afternoon XD872 began another trial but this time neither unit fired; on release the starboard unit parachute did not open, the unit exploded and then disintegrated when it hit the ground. The aircraft landed with the port unit *in situ* and after a check this fired perfectly without any adjustment or alterations being made to the installation. It was later found that a bad solder connection had caused the dual failure.

A meeting held on 23rd October 1958 discussed the problems of the Super Sprite trials and here the Air Staff stated that if six trials were successful then the installation would be cleared for RAF service. The Valiant was eventually cleared for carriage and operation of the Super Sprite installation. This part of the story has been examined here in some depth because these rocket units were dangerous, volatile and nasty to handle and fitting them to an aircraft was a really hazardous affair. I hope that the text shows, at least to some degree, how difficult this work was.

The Air Ministry very much wanted to use RATOG on all of the V-Bombers but the rapid development of more powerful jet engines in due course eliminated the need for such installations. It was better for the Ministry to encourage higher-powered engines that would give a better all-round take-off and flight performance. As a result, RATOG development came to an end in about the middle of 1959.



Flight Refuelling

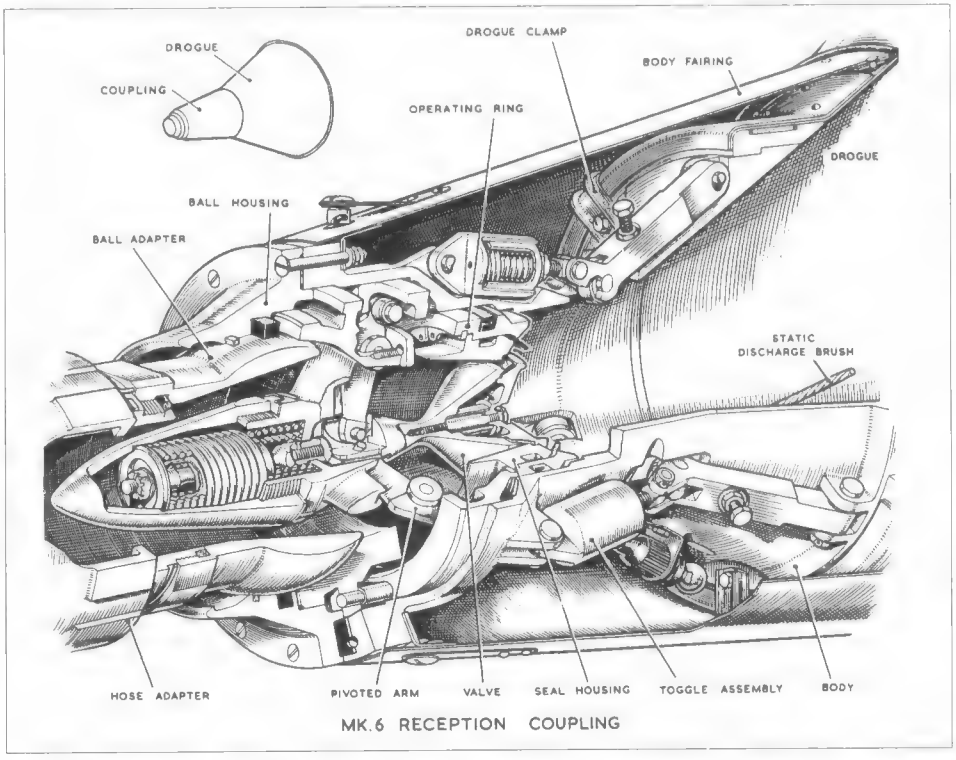
In-flight refuelling was first attempted in America in 1923 by two US Army DH.4Bs fitted with a 50ft (15.2m) hose. The first dry contact was made on 20th April and some fuel was passed during tests in May and June. British experiments also began before the war. In 1930 Sqn Ldr Atcherley designed the trailing hose technique but was refused permission to try it out, and then two years later Sir Alan Cobham commenced experiments with DH.9 aircraft using this method and completed many successful tests. In 1944 Flight Refuelling Ltd was asked to convert a number of Avro Lancaster and Lincoln bombers for long-distance operations but the end of the war stopped work on the contract. Experiments with various aircraft did continue, however, to perfect both the equipment and the technique.

The Americans carried on with their experiments and on 26th February 1949 a Boeing B-50 bomber called 'Lucky Lady II' began a flight around the world, eventually completing 23,108 miles (37,181km) in 94 hours and 1 minute and undertaking four flight refuellings. This achievement showed the rest of the world what was possible. Back in the UK there had been plenty of experiments but no real orders for equipment; for example, Flight Refuelling Ltd's fleet of test aircraft now included four Lancasters and two Lancastrians.

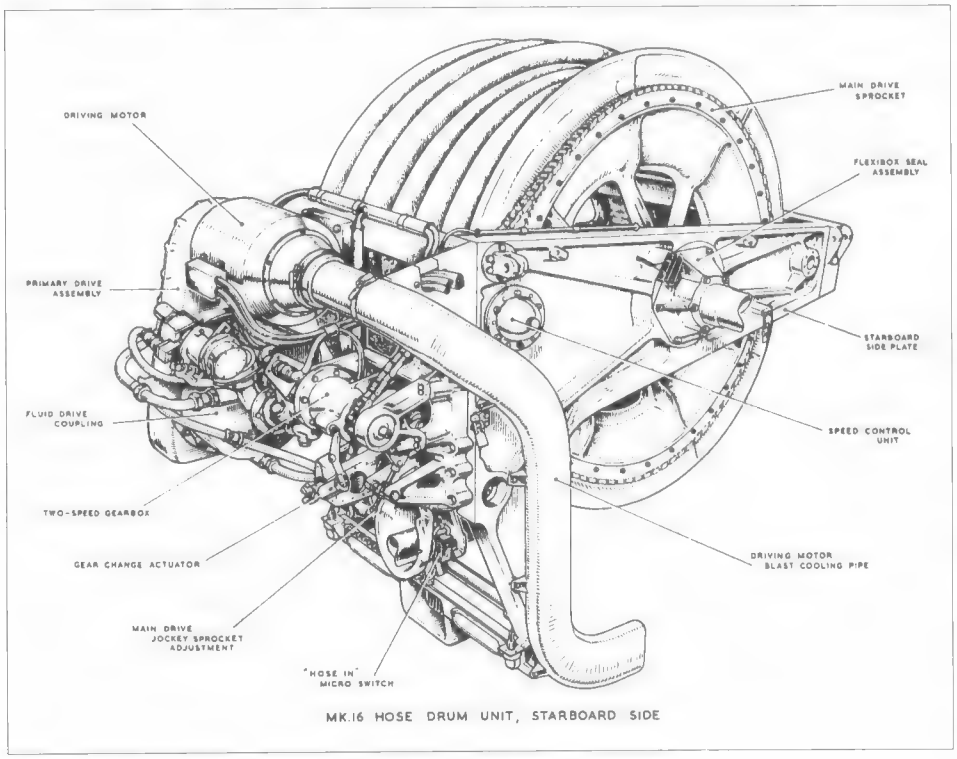
It had never been the intention to give the Valiant an in-flight refuelling capability but this eventually became perhaps the most important retrospective modification the type was to receive. The first Valiant to be so fitted was the sole B Mk.2 prototype when, just a few months after its maiden flight in September 1953, it was equipped with a drogue and reel in its bomb bay. Initially the refuelling probe was too short and had to be doubled in length but on 17th March 1954 the aircraft made a dry contact with Flight Refuelling's Canberra B Mk.2.

The main Valiant trials employed two aircraft WZ376 and WZ390, which were selected in late 1955 to assess Flight Refuelling's system. WZ376 was to be the tanker aircraft and was delivered to Weybridge on 23rd December direct from first flight and acceptance tests at Wisley; on 8th March 1956 it was classified as 'undergoing conversion' to flight refuelling. WZ390 was also taken straight from the production line and after its first flight at Wisley on 29th March 1956 it joined WZ376 for a prolonged trial programme. There were numerous teething troubles caused by airflow vibration of the hose drum unit (HDU, mounted in the bomb bay) when the bay doors were open and experimental gauge-type air spoilers were used to attempt to straighten the airflow through the bay itself. This airflow was filmed on 25th May by using wool tufts stuck onto the HDU and the surrounding structure and these showed that the airflow was extremely turbulent.

The aerodynamics of the refuelling operation were investigated for buffet and for general instability of the drogue when in the trail position. Different types of drogue were tried and the final design had longitudinal slots which did their job in stabilising the drogue in the turbulent wake of the tanker; this eventually became the Mk.9 drogue. Later WZ390 also became a tanker so that both aircraft could carry out 'wet' contacts. Trouble was experienced with fuel splashing over the receiver aircraft, which was very disconcerting for its pilot, and extensive ground tests were undertaken at Flight Refuelling to cure the problem. During the summer of 1957 it was discovered that the main pump did not function properly because a valve had tight-



MK.6 RECEPTION COUPLING



MK.16 HOSE DRUM UNIT, STARBOARD SIDE

Top: **A tanker's reception coupling with the drogue entrance to the right.**

Bottom: **The hose drum unit mounted in the tanker's bomb bay.**

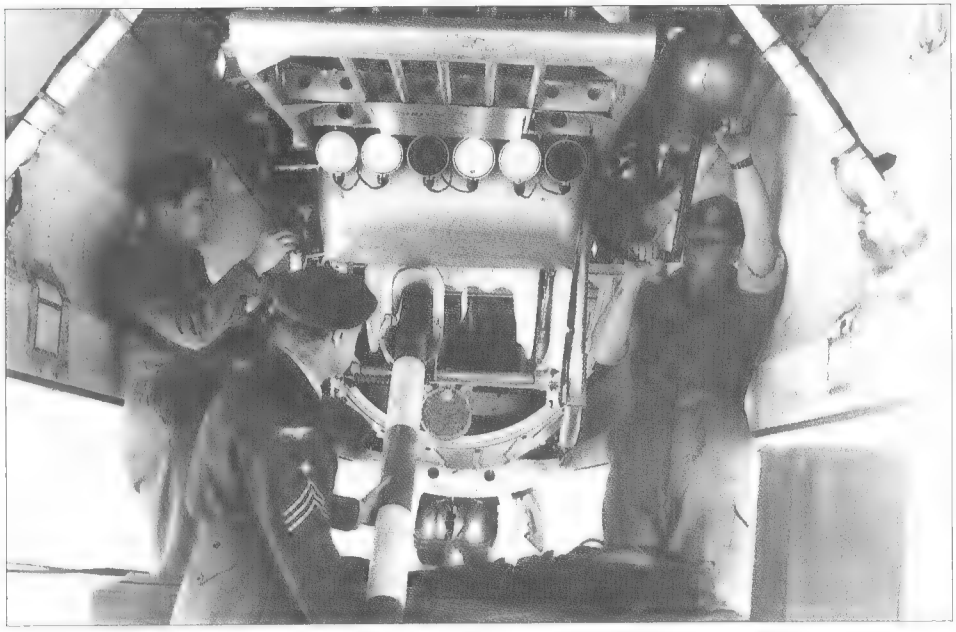
Photographs on the opposite page:

Top: **A view believed to show the first flight refuelling trial made with WZ376 and WZ390.**

Bottom: **Another shot from 1956 showing the two trial Valiants on an FR exercise.**


WZ376
WZ390

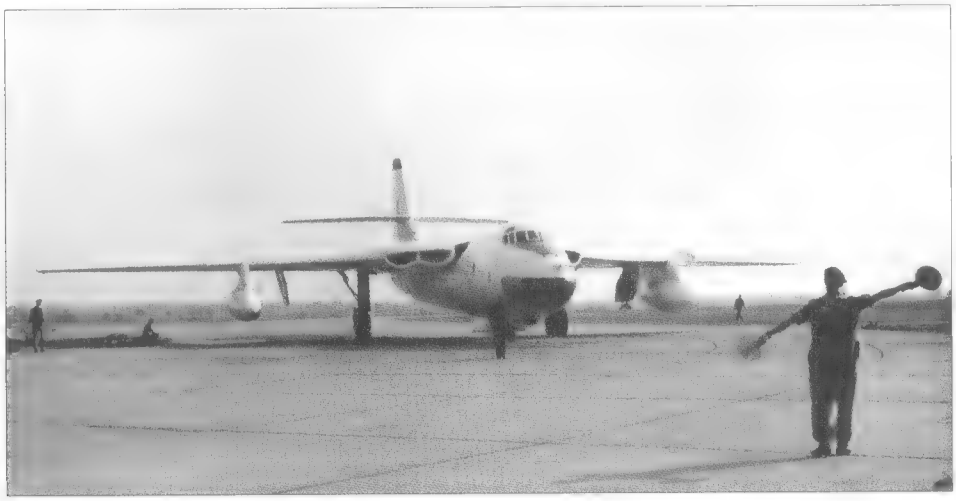

WZ376



Left: **Installed flight refuelling equipment in a 214 Squadron Valiant.**

Below: **WZ376 seen outside the hanger at Wisley. Note the drogue stretched out behind the aircraft and its own nose probe for taking on fuel.**

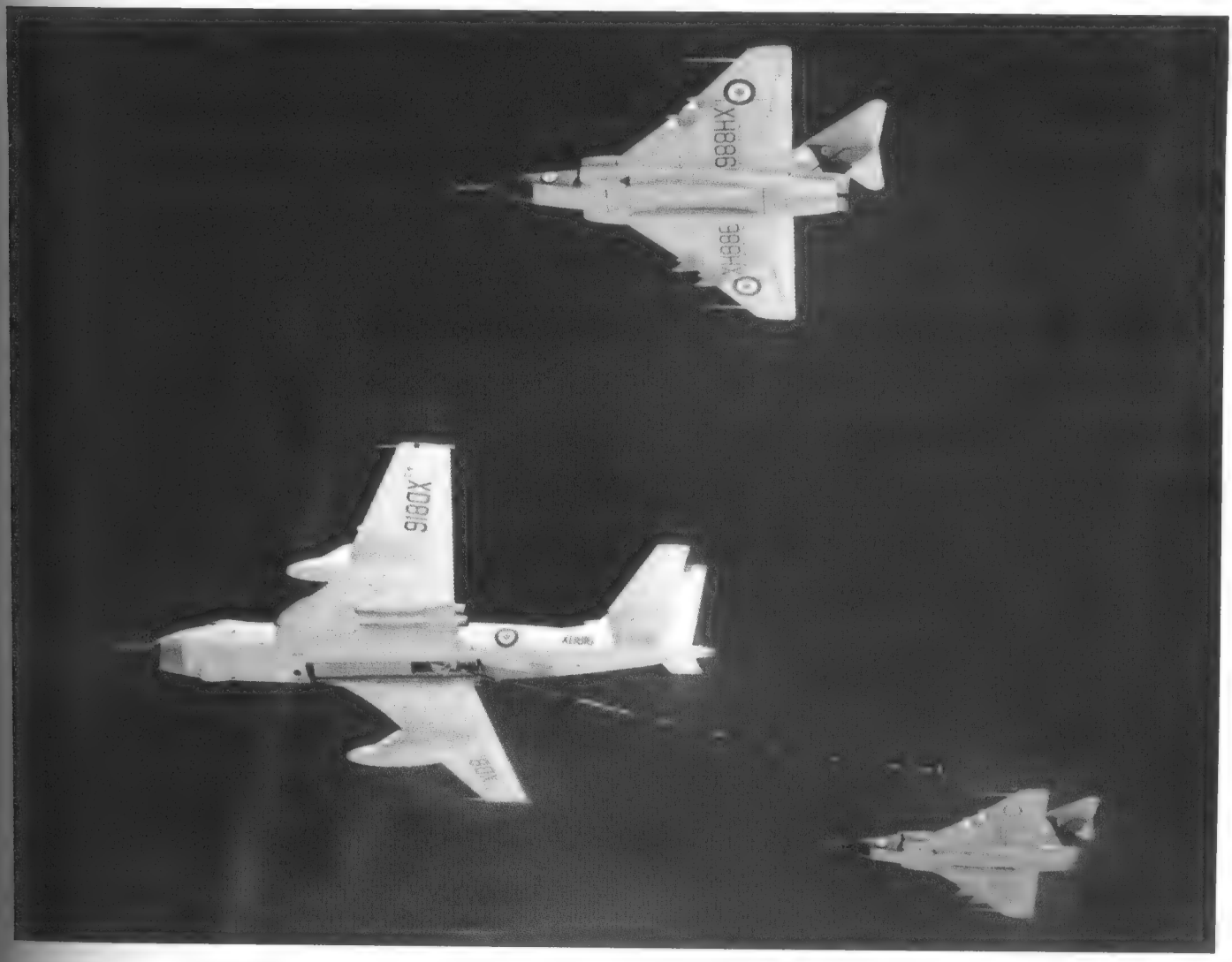
Bottom: **WZ390 of 214 Squadron arrives back at Marham on 1st June 1960 after a record non-stop flight from RAAF Butterworth in Malaya. It had been refuelled twice by Valiant tankers over Karachi and Akrotiri and the journey had taken 16 hours 16.5 minutes.**

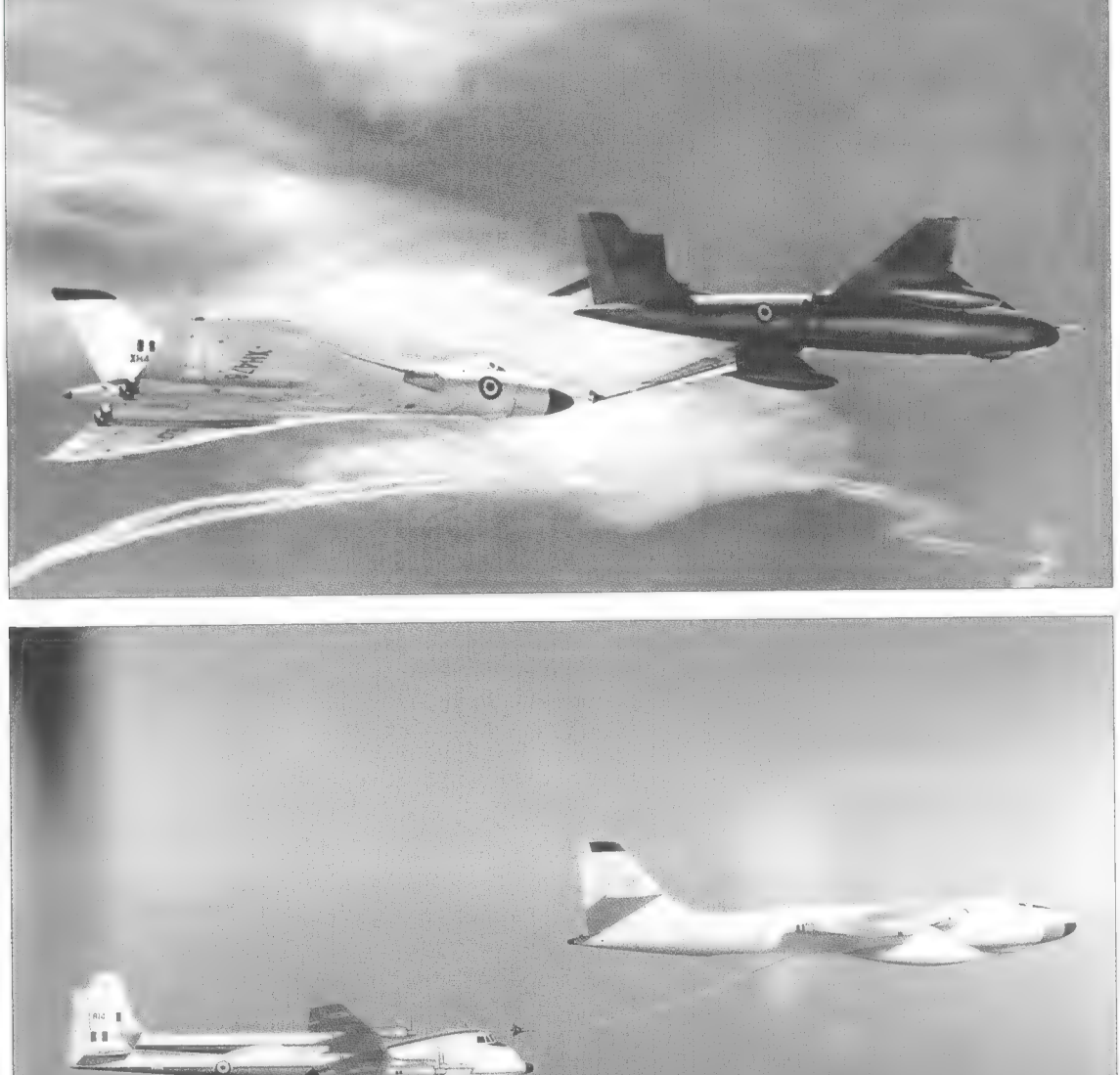


Photographs on the opposite page:

Top: **Valiant BK Mk.1 tanker XD870 refuels B(PR)K Mk.1 WZ390.**

Bottom: **Valiant BK Mk.1 XD816 from 214 Squadron trails its refuelling hose ready for two 23 Squadron Gloster Javelin FAW Mk.9s, XH88 and XH887 to take on fuel.** Tony Buttler archive





Valiant tanker (almost certainly WZ376) refuelling Avro Vulcan B Mk.1 XH478 at height.

The first production Armstrong Whitworth Argosy C.1 XN814, being 'refuelled' by Valiant BK Mk.1 XD812. Ray Williams archive

Valiant BK Mk.1 XD866 of 138 Squadron fitted with an extra-long nose probe. This aircraft served with 138 Squadron from 29th April 1957 until it moved to Wyton on 15th May 1962.

ened in the very cold air at high altitude (about -35°C at 35,000ft [10,668m]); this was cured by skimming the valve bore.

The first unit to receive Valiants fitted out for flight refuelling was 214 Squadron based at Marham and in early 1959 this unit began wet-contact trials. Once an aircraft had been given flight refuelling equipment, it could carry 10,000 gallons (45,469 lit) of fuel and transfer 5,000 gallons (22,735 lit) of it to another aircraft. During 1959 and 1960 214 Squadron carried out the following long-distance training flights:

1. 7th April 1959 – Marham to Nairobi 4,350 miles (6,999km) in 7hrs 40mins at 562mph (904km/h), Flt Lt B E Fern.
2. 28th May 1959 – Marham to Salisbury 5,320 miles (8,560km) in 9hrs 42mins at 548mph (882km/h), Sqn Ldr J H Garstin.
3. 18th June 1959 – Marham to Johannesburg 5,845 miles (9,405km) in 11hrs 3mins at 529mph (851km/h), Wg Cdr M J Beetham.
4. 9th July 1959 – Overhead Heathrow to Cape Town 6,060 miles (9,751km) in 11hrs 28mins at 530mph (853km/h), Wg Cdr M J Beetham.
5. 14th July 1959 – Overhead Cape Town to Overhead Heathrow 6,060 miles (9,751km) in 12 hrs 20mins at 492mph (792km/h), Wg Cdr M J Beetham.
6. 19th January 1960 – Marham to Offutt 4,336 miles (6,977km) in 9hrs 30mins at 461mph (742km/h), Wg Cdr M J Beetham.
7. 25th January 1960 – Offutt to St Mawgan 4,400 miles (7,080km) in 9hrs 3mins at 488mph (785km/h), Wg Cdr M J Beetham.
8. 2nd and 3rd March 1960 – Around the UK 8,500 miles (13,677km) in 18hrs 5mins, Sqn Ldr J H Garstin. (This trip was a final test before the next flight to Changi, Singapore; the aircraft was flight refuelled twice.)
9. 25th May 1960 – Marham to Changi 8,110 miles (13,049km) in 15hrs 35mins at 523mph (842km/h), Sqn Ldr J H Garstin.
10. 1st June 1960 – Butterworth to Marham 7,770 miles (12,502km) in 16hrs 16.5mins at 476mph (766km/h), Sqn Ldr J H Garstin.
11. 5th July 1960 – Marham to Vancouver 5,007 miles (8,056km) in 10hrs 28mins at 481mph (774km/h), AVM M H Dwyer.
12. 8th July 1960 – Vancouver to Marham 5,007 miles (8,056km) in 9hrs 35mins at 523mph (842km/h), AVM M H Dwyer.

A 214 Squadron Valiant made the first dry hook-up with a 101 Squadron Vulcan on 28th October 1959 and by the end of the year 214 Squadron was considered fully operational as a flight refuelling unit. In October 1960 Operation 'Dyke' saw the first large-scale refuel when, in a Far East emergency reinforcement exercise, a flight of four Gloster Javelins were supported on a trip to Singapore. Both Valiant navigators were trained to operate the flight refuel equipment but usually the job was done by the radar navigator.

The second squadron to be equipped with Valiant tankers was No 90 at Honington which relinquished its commitment to the Main Force bombing role on 1st October 1960. In-flight refuelling of much of the V-Force was now possible while other types to receive fuel from Valiant tankers included English Electric Lightnings and overseas aircraft such as the USAF's Douglas RB-66C Destroyer. Those Valiant Mk.1 aircraft adapted for in-flight refuelling only, rather than combining it with photo-reconnaissance capability (Chapter 4), were designated BK Mk.1. Aircraft so fitted were WZ400 to WZ405, XD812 to XD830 and XD857 to XD875,

Close-up of WZ376's wing, undercarriage and drop tank. The extended drogue is 'hooked up' to a Royal Navy Scimitar.

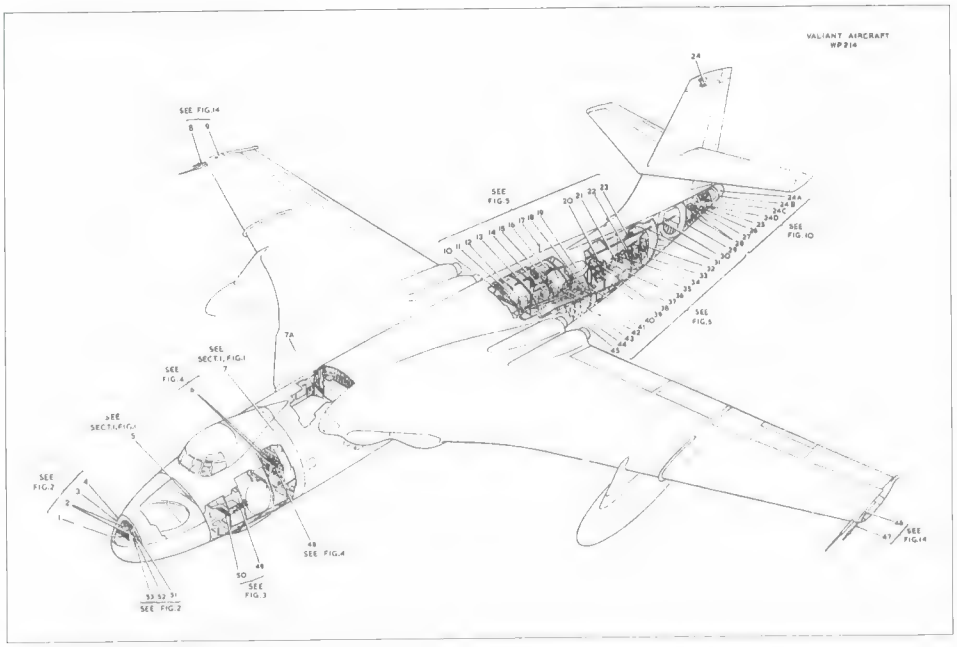
and WZ400 made its first flight on 8th May 1956. The two Valiant tanker units were primarily committed to getting Fighter Command overseas in times of tension and had no reserve to support the V-Force.

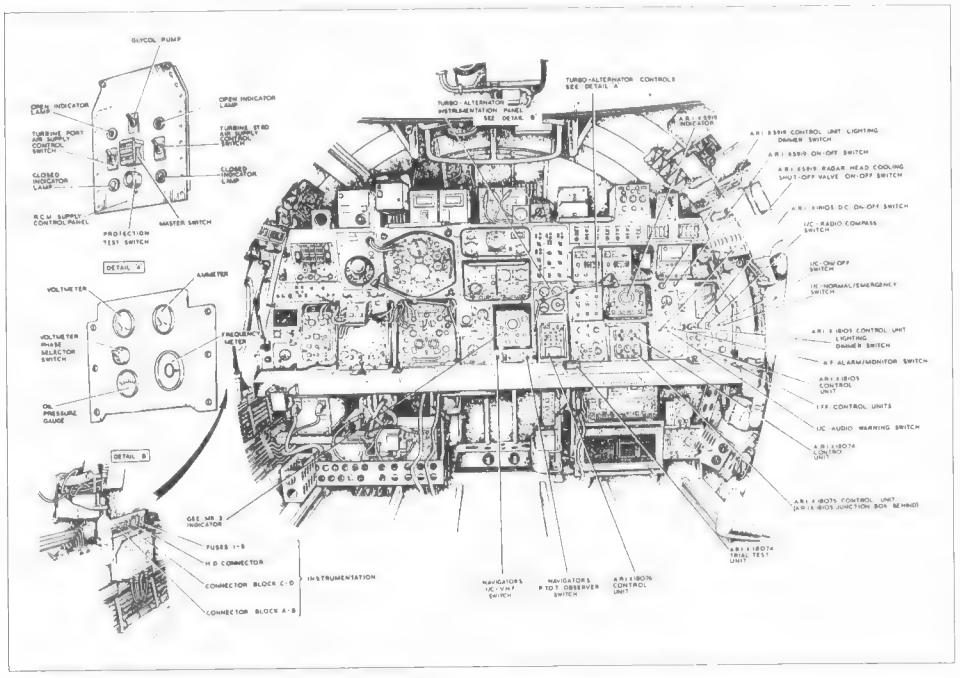
There were plans for a third Valiant tanker squadron but the Air Council agreed on 22nd November 1962 that the next unit should have Victor tankers. Two points counted against the Valiant; its fatigue life was due to end in 1968 and the Victor could carry twice as much fuel and trail three refuelling drogues instead of the Valiant's one. Nevertheless, it was the Valiant that pioneered flight refuelling in the RAF and, ever since, the technique has been indispensible to the service's operations.

Radio Counter Measures

In 1952 the Air Ministry informed Vickers that a special version of Valiant fitted with Radio Counter Measures (RCM – the term was changed to Electronic Countermeasures much later) would be required but no mention was made as to whether the equipment to be carried would be British or American. The squadron earmarked to receive RCM Valiants was No 199 because it was a unit already in being and specialised in this type of work, for which it currently used variants of the Avro Lincoln and English Electric Canberra.

In the event a British design team was given the job of producing the airborne countermeasures radio and radar equipment destined for the V-Bombers and a Valiant B Mk.1 was selected to be a test-bed. This was WP214 which had





Top left: **The general location of the Valiant B Mk.1's RCM equipment.**

Left: **The two operator's positions in Valiant WP214's RCM cockpit.**

Opposite page, bottom: **The RCM equipment mounted in WP214's rear fuselage, which altogether weighed about a ton (1.02 tonnes).**

already experienced a fairly interesting career. It had first flown on 28th March 1955 before being delivered to Gaydon on 2nd May. On 19th August it moved to RAE Farnborough to be fitted with vortex generators and first flew with these on 14th March 1956 on a trip that proved unsuccessful because the boffins' gear was unserviceable. Then WP214 went to Wisley for modifications, including fitting some RCM equipment, before flying again on 10th and 13th December 1956; RCM flight testing commenced on 27th December.

The Valiant's very extensive RCM and jamming gear was described as follows:

'The installation is mainly located within the fuselage, both above and to the rear of bomb bay, the bomb bay itself was not affected. The special equipment is mainly composed of a number of large sealed containers with their own self-contained power supply, control units, cooling systems, ducting, cables and aerial systems. There is a non-standard tail warning system of a new type (ARI.X5919) and the port fuselage transfer tank has been removed to accommodate this (which reduced fuel capacity by 355 gals [1,614lit]). The cooling systems employ a large nacelle-like structure mounted high up on the fuselage and offset to port which houses a water/glycol-to-air heat exchanger and a ram air intake for blast cooling of the power unit. The water/glycol system is self-contained with header tank, main tank and circulating pump.

'The power unit has an air-driven turbine driving a generator, the air being tapped from the main engines, and is provided with control gear and transformer and cooled by ram air. The rear fuselage has a monorail with a travelling hoist carrier to facilitate removal and replacement of the larger items of this equipment. The RCM units are designed to lift out of their specia mountings for ground checking and setting u while the tail warning system scanner head i pressurised. RCM control panels and instru mentation occupy much of the available cabi space and encroach on the areas normally used for the required operational equipment. The A Electronic Officer (AEO) station has been modified and an extra crew station introduced abov the visual bomb aimer's position. More aerials receivers and suppressors are mounted forward in the nose and at the wing tips.'

The RCM equipment comprised ARI.X591 tail warning gear (the tail warning radar wa called Orange Putter), ARI.X18074 VHF jam mer, two ARI X18075 transmitters, ARI.X1807 Red Shrimp and ARI.X18105 'S' and 'X' ban with four warning receivers. Red Shrimp was a active 'S' and 'X' band jammer with three pow erful transmitters and indeed was so powerf that a notice installed next to it noted that 'It dangerous to approach within 50 feet (15.2m of these positions whilst the equipment switched on'. AN/APR.9 and some temperatur instrumentation was also installed for servi trials purposes, the former operated from a se at the bomb aimer's position and the latter fro the crew stations.

When the jamming transmitters were in ope ation so much power was dissipated inside t aircraft that a water-glycol system had to b installed to cool the rear fuselage units. Th heat exchanger mounted inside an air intake the fuselage side formed part of the cool system while the intake on the port side of th rear fuselage transferred the heat out into th atmosphere. The rear fuselage equipment wa housed mainly in seven circular drums, ea 18in (45.7cm) in diameter, 30in (76.2cm) and weighing about 200 lb (91kg). A ve unusual feature to facilitate the removal these drums was Vickers' own design for th overhead railway which, together with ground equipment, enabled the drums to b removed from the aircraft and inserted in a sp cial trolley for servicing, a feature much appr ciated by the radio servicing crew. Fitting the huge drums plus the overhead railway mea that almost all of the original rear fuselage pip and ducting had to be rerouted while the re fuselage itself was strengthened to accomm date the intake, rear fuselage aerials and the warning equipment (an Orange Putter scan fitted in the tail cone).

For the technical experts, other installat in this special Valiant included a radio compa Type AD.7092D, Green Satin ARI.X1281 a

speed and 'miles gone' device, ARI.5848 IFF Mk.10, AN/APX.6, ARI.5829 Gee-H Mk.2, ARI.5380 high-level altimeter, Window launching equipment, H2S – NBS, ARI.5874, ARI.5851, ARI.18011 and ARI.18064 including TR.1985 and TR.1986. To counteract the massive weight increase to the rear fuselage, a total of 499 lb (226kg) of ballast needed to be loaded in the nose (provided that the H2S scanner had been removed). The total weight of the RCM removable equipment was 2,646 lb (1,200kg), the basic weight of the aircraft was 83,744 lb (37,986kg), a crew of six plus miscellaneous items raised this to the operating weight of 85,720 lb (38,883kg) and 9,617 gallons (43,728 lit) of fuel added 74,052 lb (33,590kg) to give an all-up-weight of 159,772 lb (72,473kg). Once problems with the glycol cooling had been sorted this equipment was tested and found to be satisfactory and was also scheduled to be fitted in the Victor and Vulcan.

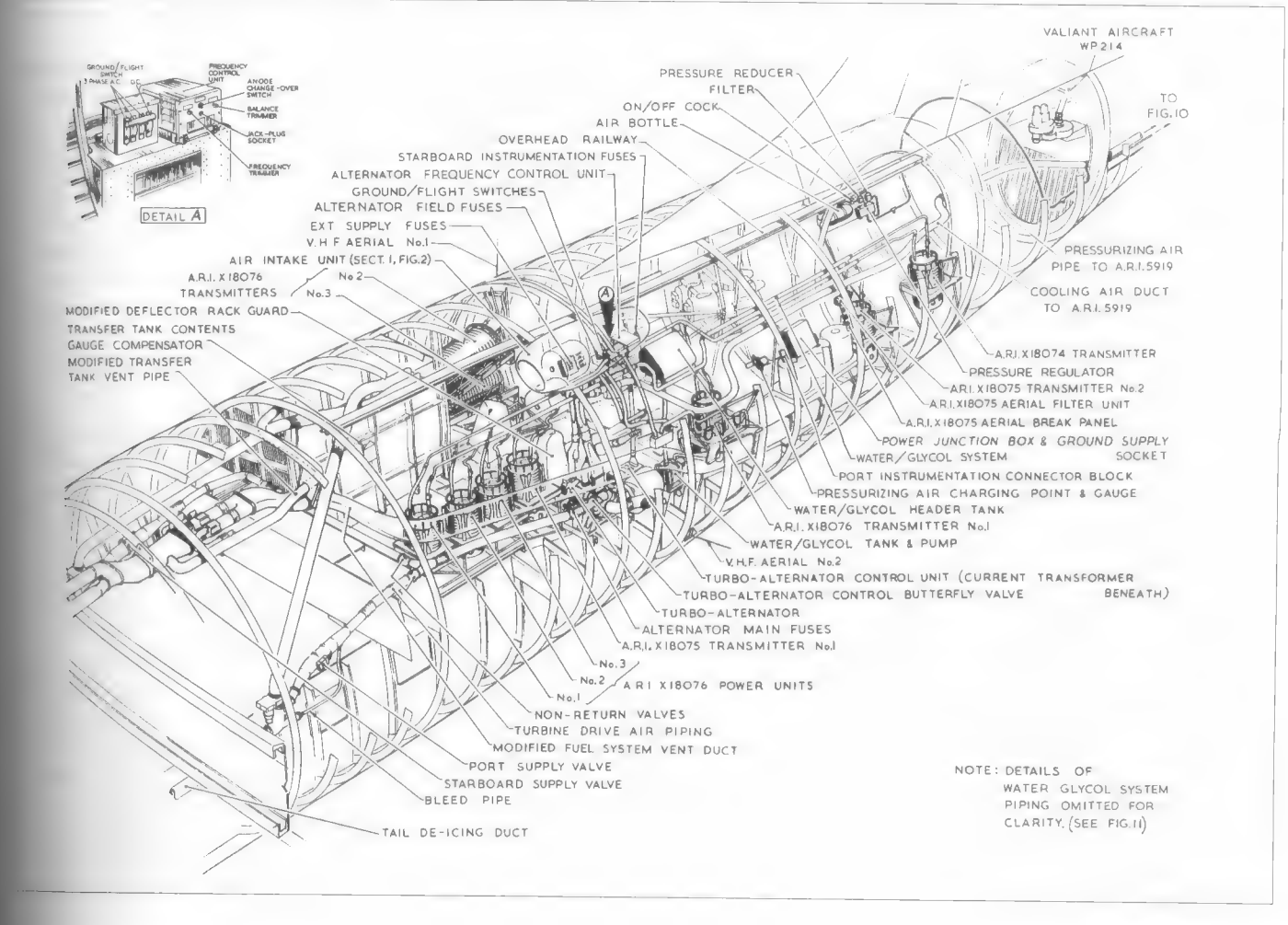
WP214 commenced Phase 3 trials in the first week of June 1958 and in July it was flown to Canada for more trials before returning in the first week of August. During this programme overcooling of the RCM equipment was experienced and the turbo alternator proved unsatisfactory, the first having failed in the UK after only 72 hours, the second in Canada after 56 hours and the third during ground running; another flown in from the UK did work satisfactorily. Phases 4 and 5 trials required the use of the Navigation Bombing System and H2S.

Despite 199 Squadron supplying RCM for the V-Bombers, it could not fully cover such a widely dispersed force and so other aircraft (Vulcan and Victor Mk.2s) eventually received their own RCM/ECM gear. In 1959 the Air Staff gave full authority to introduce RCM into the Victor and Vulcan and Victor B Mk.1 XH587 became the Victor development aircraft and was redesignated B Mk.1A. Its RCM equipment was fitted in the H2S radome and in the former bomb bay and the aircraft also received a revised tail cone with a backward-facing scanner for tail warning.

The first RCM Valiants went to 199 Squadron 'C' Flight at Honington in 1957 where they were joined initially by 199 Squadron Canberras. In December 1958 these Canberras were withdrawn and the Valiants moved to Finningley where their unit was renumbered 18 Squadron. On 25th September 1959 Wg Cdr D J Roe at Finningley told HQ Bomber Command: 'The fact that these aircraft (seven 18 Squadron Valiants including WP212, WP213, WP215, WP216 and WZ365) are non-standard has been partially recognised by certain entries in the Pilots Notes. However there has been no official recognition on the technical side which leads to many difficulties in documentation and servicing and also in the installation of approved modifications.' Roe finished by writing: 'It is strongly recommended that a special type number should be given to Valiants of No18 Squadron; this should save time and effort in servicing and maintaining these aircraft and would lead to greater utilisation.'

A meeting held at Finningley on 26th February 1960 was intended to investigate the possible re-engineering of the ECM installation in 18 Squadron Valiants. The plan was to fit, in lieu of the existing equipment, Red Shrimp with two transmitters, two power units and a control unit and Red Carpet with a 'putting on' receiver (APR9) or ARI.18145 or ARI.18146. The problem was, did the present installation (which used an air-bleed turbine) supply enough power to accommodate these changes?

Vickers got the job of assessing the new arrangement but, first of all, WP214 had to finish its present trials which needed another 80 hours of flying before September 1960. Following the aircraft's return to Vickers, the new installation would be fitted by December 1960 and was to be followed by a test programme of ten hours of acceptance trials and up to 110 hours of trials flying with completion in August 1961. On 2nd September 1960 it was agreed that this should go ahead but the timetable soon slipped. WP214 arrived at Weybridge on 2nd December ready for the conversion to begin; it flew to Finningley on 5th May 1961 and completed 24 hours 45 minutes of development flying between 7th June and 14th September.



Left: **Test ejection of a pilot's seat from WP199 moving at 100 knots (185km/h) along the runway at Martin-Baker's headquarters at Chalgrove.**

Bottom left and centre: **Martin-Baker's triple-seat arrangement proposed for the Vulcan's rear crew did not go into service and, in fact, was never tested.**

Bottom right: **The specially designed seat used for test ejections of backward-seated crew in the Valiant and other V-Bombers.**

Ejection Seats

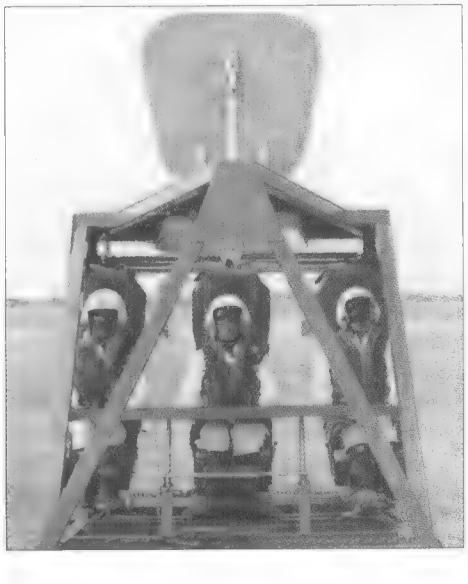
The question of ejection seats for V-Bomber crew members had been at the forefront of Air Ministry thinking. The loss of Avro Vulcan B Mk.1 XA897 on 1st October 1956 at London Heathrow brought into question the method of escape available for V-Bomber crews. In this accident the two pilots ejected safely but all four rear crew members lost their lives because they had no ejection seats. A contemporary American bomber, the Boeing B-47, had ejection seats fitted for all of its crew; however, this aircraft had downward-firing ejection seats and at no time did the Air Ministry or Martin-Baker consider this method of escape for the V-Bombers because it needed at least 800ft (244m) of clear air to effect a safe departure. In other words there was no escape if an accident happened on take-off or landing. The ejection seat selected for the Valiant was the Martin-Baker Type 3A.

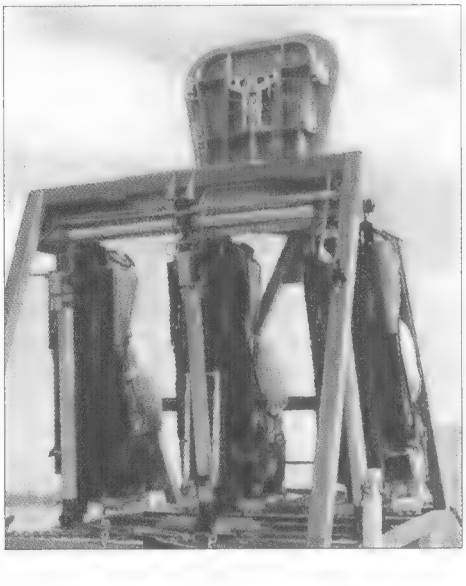
As already illustrated, Vickers had done a rough sketch of an escape capsule which made up the entire pressurised nose section and contained all of the crew, but this would have been too costly in man hours and money. James Martin of Martin-Baker Aircraft investigated the problem and designed a triple-seat combination for the three rear crew members. A contract was awarded to Martin-Baker for research and on 11th September 1959 WP199 flew to the company's airfield at Chalgrove for installation and testing. However, Martin-Baker decided that a single rearward-facing seat would be the most suited for the ejection trials and one was duly fitted in WP199 in the middle of the three back seats. It was surrounded by a blast screen of unpainted metal to protect the other crew members and had two guide rails to take it up to the roof of the cabin.

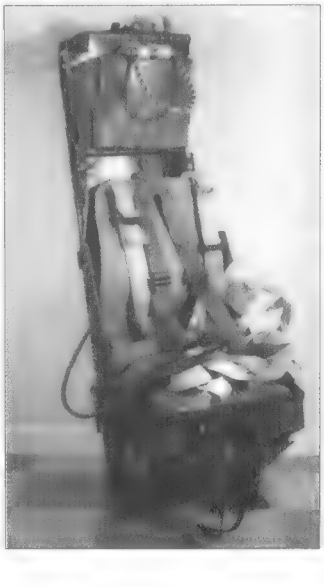
Some test runs were scheduled to check the seat, its rockets and the room available for the 'passenger' when he went through the 'hole' in the cockpit roof. The first was made on the runway when WP199 had reached 100 knots (185km/h), the second and third were both made at 200ft (61m) at 250 knots and 300 knots (463km/h and 556km/h) respectively. Test number one was accomplished on 27th June 1960, the parachute being fully deployed 4.3 seconds after the ejection was initiated which allowed for a fully controlled drop of 38ft (11.6m).

The first live ejection was made over Chalgrove on 1st July 1960 and was witnessed by a group of RAF officers from the Ministry of Aviation and Headquarters Bomber Command. W T 'Doddy' Hay successfully departed at a height of 1,000ft (305m) and a speed of 250 knots (463km/h) and landed in the middle of the aerodrome after a really uneventful sequence of events and a controlled descent; this was the first live backwards ejection from a British aircraft. The first such ejection is believed to have been made from a wartime German Heinkel He 219 night fighter fitted with rearward-facing ejection seats. During tests one German Erprobungsspringer Willi Buss, ejected three times from the He.219.

Vickers' designer George Edwards said that the structural difficulties in providing these seats for the rear crew would prejudice the design of the cabin canopy; as illustrated below, this design would certainly have been very cumbersome within the confines of the small Valiant cockpit. Had the main triple ejection seat been fired, the centre seat was to go first while the port and starboard seats would automatically move sideways towards the centre, then first the port and then the starboard seat would eject through the same exit. The time taken to eject all three must have been comparable to each crewman baling out of the side entrance hatch. This particular arrangement was designed by James Martin to go in the Avro Vulcan and he was prepared to fit an example at his own expense if the Air Ministry had loaned him a Vulcan. The offer was turned down and no aircraft was ever fitted with the triple-seat escape system. The Valiant's rear aircrew had to settle with escaping through the side entrance and this was successfully accomplished on a couple of occasions without anyone sustaining any injuries.







Service Career

Suez, Non-Nuclear Duties and Switch to Low Level

Once 138 Squadron had achieved a full complement of eight Valiants, the conversion of other units was swift. No 543 Squadron received its first machine on 1st June 1955 while two more bases, Honington and Marham, were made ready for the aircraft in the following year. Nos 214, 207 and 148 Squadrons were all formed in 1956 to become the Marham Wing and the first Honington unit, 7 Squadron, formed in the autumn.

Valiant WP209 was the first V-Bomber to fly overseas when it left RAE Farnborough on 31st July 1955 for six months of armament and bomb ballistic trials at the Long Range Weapons Establishment (LRWE) at Woomera in Australia. A meeting between Vickers and the Air Ministry held at Weybridge on the previous 5th January had discussed preparing WP209 for these trials under Contract 6/Aircraft/11586/CB.6(c), which covered installing two wing tip cameras, one bomb bay camera and some ballistic lamp equipment; of course, the aircraft still had to carry a 10,000 lb (4,536kg) bomb.

WP209 was one of the MoS's own Farnborough-based aircraft and its crew comprised Wg Cdr J Finch OBE DFC AFC, Sqn Ldr J R Tanner, Flt Lt A Sacks, Flt Lt D Fish, Flt Lt J C L R Labelle MBE and B A Maries (an RAE Inspector). On the outboard flight it flew Farnborough to Habbaniya 2,400 miles (3,862km), Habbaniya to Karachi 1,416 miles (2,278km), Karachi to Negombo 1,346 miles (2,166km), Negombo to Changi 1,625 miles (2,615km), Changi to Darwin 1,812 miles (2,916km) and Darwin to Woomera 1,181 miles (1,900km) while also setting up two official course records – London to Baghdad at 523.5mph (842km/h) and Singapore to Darwin at 518.4mph (834km/h). The total distance was 9,780 miles (15,736km) in 22 hours 50 minutes flying spread over four days. WP209 flew back to Wisley on 13th April 1956 for an engine change but in September another Valiant flew to Tripoli to undergo preliminary tropical trials.

Top left: **Spectacular view of Valiant B Mk.1 WZ365 with undercarriage and flaps down. It is thought that this picture shows it landing at Farnborough for the SBAC Air Show on about 4th September 1955.**

Left: **WZ365 shows off its undersides and engine arrangement at the 1955 Farnborough Show. This aircraft served with 232 OCU, 199 Squadron and 18 Squadron.**

In time many Valiants would go overseas although none were ever to be permanently based abroad, bar one or two trials aircraft. Two more, WP206 and WP207 commanded by Sqn Ldr R G Wilson DFC, left Wittering on 5th September 1955 for Operation 'Too Right', the first part of which was to be a proving flight for 138 Squadron to fly to Singapore. A goodwill tour of Australia and New Zealand followed including demonstration flights in Sydney, Melbourne, Canberra, Hobart, Adelaide, Christchurch and Wellington and the chance for RAAF and RNZAF aircrew to fly the aircraft. 'Too Right' also showed how the forthcoming V-Force would have a global capability operating from bases anywhere in the world. During the tour the two aircraft completed a total of 146 hours flying.

Overseas detachments gradually became more frequent and routine. For example, two aircraft from 214 Squadron went to Idris in June 1956 for Exercise 'Thunderhead' which was intended to test NATO's defences in southern Europe and around the Mediterranean. On 1st September another 214 aircraft made the first non-stop transatlantic flight by a V-Bomber when it flew from Loring AFB direct to Marham.

It is very seldom that a high speed aircraft has to land with its undercarriage still up, but this is precisely what happened at 18.00 hours on 7th October 1955 to Valiant B Mk.1 WZ370. Despite the crew trying all of the emergency lowering procedures, the starboard undercarriage refused to come down but, fortunately, a successful wheels-up landing was made at the Vickers test airfield at Wisley. The purpose of the flight had been to check a new rudder power control unit followed by engine checks at 45,000ft (13,716m).

On the climb, at approximately 22,500ft (6,858m) and 280 knots (519km/h), a bang was heard by all of the aircrew. On a previous flight a similar noise had also been heard and attributed to a 'panting' skin panel on the pressure cabin but the flight had been continued and the programme completed. After about three and a half minutes WZ370 rejoined the circuit and the undercarriage was selected down as normal. The nose wheel and the port main gears came down and locked but the starboard door refused to budge. Emergency down was selected but with no effect and so the extreme emergency system was then attempted using explosive bolts on the starboard undercarriage door. The undercarriage doors now opened correctly but there was still no apparent movement of the chassis.

The only alternative was an emergency landing. The undercarriage was selected up, although the starboard undercarriage door had to stay down because using the extreme emergency system meant it could not be raised again, and preparations were made for a belly landing. The light was fading and there was no time to jettison any fuel to reduce the all-up-weight; all moveable items, including the rear crew's parachutes, were stowed in the bomb aimer's compartment. Landing drill was agreed between the two pilots and the main entrance door was jettisoned but then hit the wing leading edge after release. Full flap was selected rather early on the final approach and a fairly steep approach was made so that the aircraft's speed could be held to approximately 120 knots (222km/h) IAS over the fence; touchdown was achieved at a weight of about 97,000 lb (43,999kg) with a landing speed of 100 to 105 knots (185 to 195km/h). The impact shock was negligible and the aircraft seemed to skip over the ground with only a very slight initial deceleration, so the pilots pushed the nose hard down using full elevator.

The bomb aimer's compartment was forced upwards which distorted the cabin floor and pushed one of the vertical floor supports up through the floor. The aircraft came to rest 2,050ft (625m) from first touchdown, all of the crew escaped without injury and there was no fuel spillage or outbreak of fire. There was, however, damage to the starboard wing and flap unit caused by the undercarriage door being wrenched backwards, and general damage to the aircraft when it settled down on the flaps during the landing run.

The next day WZ370 was jacked up, the undercarriage was lowered using a 28 volt slave rig and then the aircraft was taken into a hangar for examination. It was found that a fire bottle in the service bay forward of the starboard main undercarriage bay had exploded (which made the bang heard by the crew) and then the starboard main undercarriage fuses in the 'organ loft' had blown. It was discovered that a short circuit in the main starboard cable had thrown the wiring loom against the de-icing duct bellows causing a short circuit that blew the fuses. The fire bottle explosion was assumed to have been due to hot air leaking from the airframe de-icing gate valve blank but there were also strong signs of overheating in the electrics.

In July 1956 Her Majesty the Queen inspected Bomber Command units at Marham and viewed an impressive display of the Command's aircraft with, of course, the Valiant at the forefront. However, the Valiant was soon to be in action. On 26th July Colonel Gamel Nasser, the President of Egypt, announced that he was nationalising the international company which controlled the Suez Canal (the Anglo-French Suez Canal Co); this was in breach of international agreements and was, in effect, robbery because the canal was financed by the UK and France. In response, troops and aircraft were sent to Malta and Akrotiri in Cyprus in an attempt to protect both countries' interests. Included in the hurriedly assembled UK forces were Valiants from 138, 148, 207 and 214 Squadrons which, in theory, could reach the battle area from Malta and return without difficulty. A total of 24 Valiants were deployed, a full complement of eight from 138 Squadron, six each from 148 and 207 Squadrons and four from 214 Squadron.

After an ultimatum by the British and French Governments had been rejected on 31st October Operation 'Musketeer', an Allied air offensive or 'policing action', was put into effect. The first phase, from 31st October to 1st November was designed to eradicate or neutralise the Egyptian Air Force. Airfields around Cairo were repeatedly attacked destroying many aircraft on the ground and by 3rd October the Egyptian Air Force was pretty well rendered incapable of mounting any attacks against UK forces. The second stage was a move against other military targets before phase three brought a paratroop drop to occupy key areas around the canal. For Malta-based Valiants these operations meant a five-hour 1,800 mile (2,896km) trip with around 15 minutes spent over enemy territory.

WZ370 seen after its wheels-up landing at Wisley on 7th October 1955.

WZ403 complete with its special motorised ground hoist for lifting the heavy drop tanks up to the wings.

The first Valiant to drop a bomb in anger was XD814 of 148 Squadron just after 7.00pm on the evening of 31st October when it deposited a load of standard 1,000 lb (454kg) HE bombs from 40,000ft (12,192m) on Almaza airfield. This particular attacking force consisted of five Valiants from 148 Squadron and one example from 214 and each aircraft bombed individually. Everyone within 214 (the author was with the Squadron at the time) had initially just assumed that this was some sort of exercise; not until the Valiants had landed in Luqa was the real situation revealed.

Almaza was found easily because Egyptian towns were still fully lit with no blackout, while the airfield had already been bombed and marked by a Canberra from 10 Squadron. Several aircraft made two bombing runs to ensure they had the correct target since casualties were to be kept to a minimum and some anti-aircraft fire was seen well below the attackers. During the entire campaign only one Valiant crew reported being attacked by an Egyptian Air Force night fighter (probably a Gloster Meteor NF.13) which fired two bursts but the bomber, piloted by Sqn Ldr E T Ware, lost its attacker after taking evasive action. This showed that the Valiant possessed sufficient performance to be able to evade the current generation of night fighters.

The Americans had reacted rapidly to the situation in Suez and sent 15 large transport aircraft to Cairo West to evacuate their own nationals from the danger zone. However, that airfield was one of those selected for bombing and a force of six Valiants were fortunately recalled just as they were entering Egyptian air space to attack. That same evening two Valiants commanded by Sqn Ldrs Wilson and Collins dropped proximity markers and 11,000 lb (4,990kg) of bombs on the airfield at Abu Sueir. The raid had to be carried out using techniques employed during World War Two because the aircraft's new NBS had not yet been installed. The bombing was reported as accurate with no fighters or anti-aircraft fire encountered by either crew.

During the following night Valiants and Canberras attacked Cairo West, Fayid, Kasfareet and Luxor but post-raid reconnaissance this time showed that the airfields had suffered relatively minor damage. The Valiants were supported at Luqa by seven Canberras from 109 Squadron while another 22 Canberras were housed at Hal Far and 59 on Cyprus for both bombing and target marking. On the fourth night both Valiants and Canberras attacked radar and coastal installations at Alexandria while a raid on Agami Island proved to be the final Valiant mission.

In all, RAF bombers flew 337 sorties (49 by Valiants) and dropped a total of 942 tons (957 tonnes) of bombs on Egyptian targets before international pressure brought the raids to a close. The last RAF operation was flown on 5th November, by which time bombing sorties had been completed against targets at Abu Sueir, Almaza, Cairo West, Fayid, Kabrit, Kasfareet and Luxor, Huckstep barracks, Agami Island (a submarine repair depot) and Nifisha marshalling yards.

Phase three operations commenced on 5th November when British and French parachute troops were flown from Cyprus and dropped just after daylight at Port Said at the north end of the Suez Canal. The following day British Army Commandos and Royal Marines began to go ashore at Port Said followed in the afternoon by two parachute battalions. The 1st Parachute Battalion took part in some fighting in the town, whilst the 2nd Parachute Battalion advanced 25 miles (40km) down the side of the Suez Canal to El Cap. At 6pm the British Prime Minister, Sir Anthony Eden, announced a cease fire.

No other country supported the UK and France in these operations; both the USA and Canada were against the campaign together with the United Nations (none of these countries had a stake in the canal) and so to have continued these actions would have gone against world opinion. An American resolution at the United Nations General Assembly was adopted on 2nd November by 64 votes to five with six abstentions; at least three others seem to have voted for the continuance but to no avail, the action had to be stopped. Colonel Nasser stayed in power and held on to the Suez Canal.

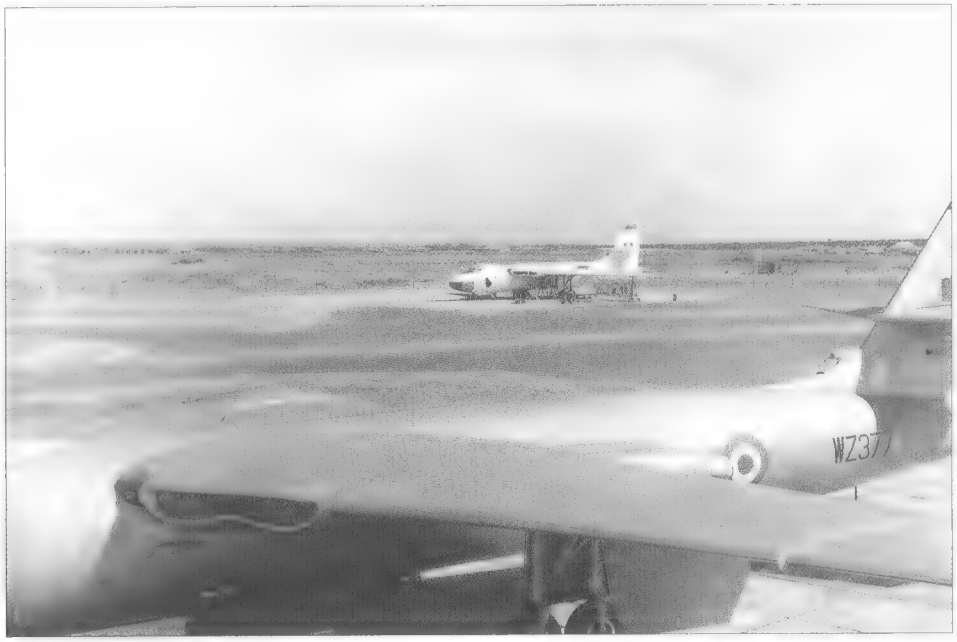
Such was the British state of unpreparedness that only a few Valiants had received NBS (H2S Mk.9a Yellow Aster with a Navigational Ballistic Computer) and those that had it suffered teething problems. For example, two out of five that bombed Almaza reported NBS as unserviceable and so to bomb from 40,000ft to 45,000ft (12,192m to 13,716m) they had to fall back on their visual bombsight. Problems also affected navigation and most crews had difficulty in finding the right airfield to bomb or finding their way back to Malta. The Gee-H navigation aid was installed but no Gee-H ground stations were available in this area, so to navigate pilots had to use their Green Satin Doppler and a periscopic sextant which basically took the situation back to World War Two standards of aiming visually on target indicators. The raids were carried out at night so a pathfinder system was employed, similar to World War Two, using target-marking Canberras but this did not always work and the generally disappointing high-level bombing performance meant that most of the follow-up raids had to be made by low-level strike aircraft.

Another problem was that even the bombs, plain HE (High Explosive), were not cleared for carriage by the Valiants because, as we have seen, bomb release had been one of the few troubles to affect the Valiant's development trials. During Suez there were some hang-ups and it is believed that, under the circumstances the piston-engined Avro Lincoln might have done better. Early trials had revealed that when it was released at high speeds a bomb could be suspended for a period by the airflow just a few feet under the bomb bay, something guaranteed to muck up the bomb aimer's accuracy.

The weather was always fine over Suez but three raids from Malta were cancelled because of problems expected with local bad weather when returning to land. Only 50% of the bombs dropped landed within 650 yards (594m) of the designated target which cannot be considered as satisfactory. On the plus side no Bomber Command aircraft were lost while these operations were being made 'out of area', meaning that crews had had insufficient time for training. It would have been interesting to see how the Valiants might have performed had they been in service for a year or two longer with all of their navigation aids fitted. Much indeed had been learnt.

Following Suez, the Valiants and most of the other squadrons left their crowded Mediterranean bases, but one Canberra unit stayed in the area until 1957. That year Operation 'Golflake' was put into effect as a safety measure against any further trouble from Egyptian forces and two more Canberra squadrons were flown in. They were joined by Valiant WZ401 on 18th October 1957 and by WZ384 in November, temporarily detached to Malta.

Another ongoing exercise taking place out of Malta was Operation 'Sunspot' which was a long-distance navigation exercise and visual bombing practice held regularly over the local Maltese and Libyan ranges. Such trips to the sunnier climate were popular and were not restricted by the conditions usually experienced in Europe; the first Valiant to participate was WZ404 which flew out on 2nd March 195



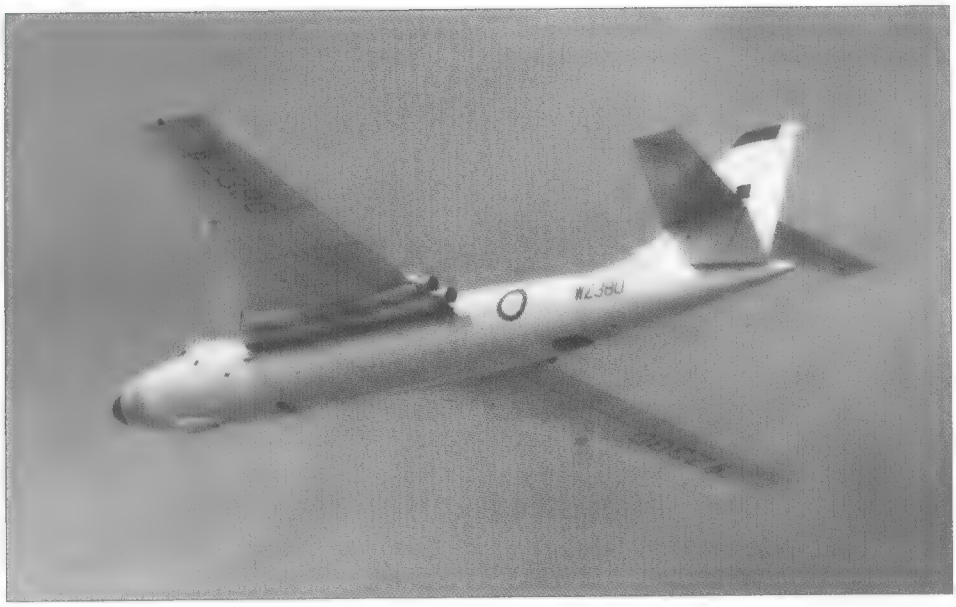
Top left: **The scene at Akrotiri in Cyprus on 13th November 1956, just after the Suez campaign. All of the ground crew were living in tents and it was back to the jungle with minimal facilities for shaving and ablutions; the nights were pretty cold. Most of the aircrew had somewhat better accommodation.**

Left: **A lovely picture showing WZ365 above the clouds. Just visible are the aerodynamic aerofoil surfaces attached to the wing fuel tanks – the Valiant wing tanks were never meant to be jettisoned because there was little difference in the aircraft's performance when carrying them or not.**

Photographs on the opposite page:

Top: **XD813, a BK Mk.1, about to touch down.**

Bottom: **WZ405 from 207 Squadron photographed at the USAF Armed Forces open day at Burtonwood on 18th May 1957.**
Phil Butler collection



Top: **WZ380, a B(PR)K Mk.1 of 543 Squadron, seen during a 'Snow Trip' exercise in Canada in November 1956 while on trials with A&AEE.**

Below: **WZ400, reputedly photographed over Goose Bay.**

Photographs on the opposite page:

Top: **The last production Valiant, B(K) Mk.1 XD875, takes off from Brooklands on 27th August 1957 and prepares to say its farewells.**

Bottom: **XD875 makes a flypast over the Brooklands Club House on 27th August 1957. This is now (2002) part of the Brooklands Museum and has been renamed the Sir Barnes Wallis Club House.**

This trip, however, also included testing at El Adem but was interrupted from 11th to 18th May by Operation 'Shahbaz', an exercise based at Mauripur outside Karachi involving four Valiants sent specially for further trials.

The following year saw XD872 begin a 'Sunspot' trip on 11th April; in 1959 it was the turn of XD868 and XD872 on 9th January followed by WZ384 and XD823 from 20th January, WZ402 on 30th January, XD822 and XD824 on 13th February, XD827 on 11th March, and XD864 on 6th August. However, 1960 seems to have been the big year with 'Sunspot' going out in a blaze of activity; the following Valiants took part: WZ384 started things off on 3rd April, WP221, WZ404, WZ405, XD813, XD858 and XD875 followed on 11th August and XD818 brought the exercises to a conclusion in September.

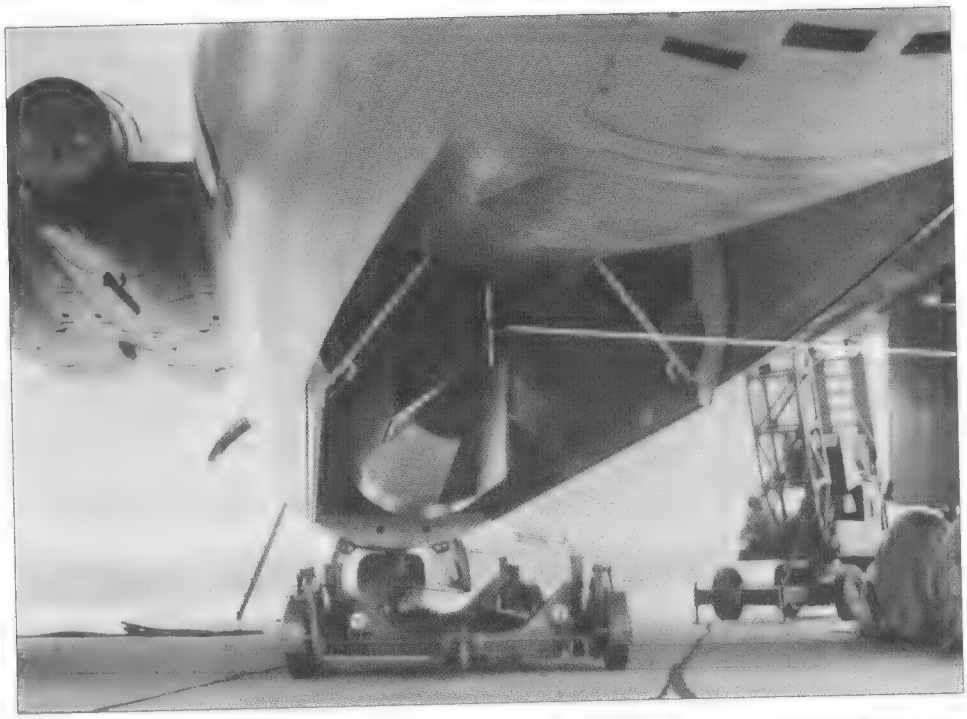
Another exercise, in stark contrast to 'Sunspot', was Operation 'Snow Trip'. Here Valiants were sent to Canada to carry out a survey of the Distant Early Warning (DEW) radar chain across the Canadian Arctic border. Three aircraft are known to have been dispatched: WZ391 left the UK on 28th March 1956, WZ380 on 3rd October 1956 and WZ399 from 543 Squadron also in October 1956.

Between 23rd and 30th April 1959 two Vulcans and four Valiants from 148 Squadron at Marham participated in Exercise 'Eyewasher' an Eastern Nomrad (North American Air Defence) region operation. The objective was to test North America's Eastern Air Defence Command by trying to penetrate the DEW line situated in the north-east of Canada. The RAF was asked to take part because no USAF aircraft of suitable range or performance were available and the V-Bombers were based at Goose Bay in Labrador. They flew their exercise on the night of 25/26th April, flying in over Frobisher, the Valiants at 42,000ft (12,802m) and the Vulcans at 48,000ft (14,630m), and of the six aircraft flying, only one was challenged.

The V-Bombers were not just employed in wartime roles; occasionally more humanitarian duties were needed and an example was the swift dispatch of two 543 Squadron Valiants to Jamaica in late 1961 to undertake a survey of British Honduras. The area had been devastated by a hurricane and the squadron's PR aircraft were well suited to assessing the damage. The survey began on 10th December and lasted ten days. Another 543 detachment spent six weeks from August 1962 surveying the Solomon Islands, Santa Cruz and the New Hebrides under Operation 'Bafford', for which they operated out of Townsville in Australia, Port Moresby in Papua New Guinea and Nadi in Fiji.

No 543 Squadron based at Wyton was becoming an expert unit in this type of work. In June 1964 three of its aircraft performed Operation 'Pontiflex', a major survey and mapping of the Rhodesias and Bechuanaland (which today are called Zambia, Zimbabwe and Botswana). A period of four months was needed to take 20,000 photographs covering 400,000 square miles (1,036,000sq.km) but the results revealed substantial errors in previously available maps. Lake Bangweulu was revealed to be a different shape to that previously recorded and further errors of up to 16 miles (25.7km) were also found.

On 1st July 1959 three Valiants, WZ366, XD866 and XD868, began Operation 'Profitee', a two-week detachment of Valiants, at three-monthly intervals, to RAAF Butterworth



Left: **A 10,000 lb (4,536kg) MC bomb seen in the bomb bay of WP199 in December 1955 during trials; the bomb bay deflector is in the 'up' position.**

Below: **A posed 'scramble' by a Valiant aircrew - Sqn Ldr G D Cedlef AFC, Flt Lts C F Welf, M Meadows and A Myers, Flg Off W A Wing and Chief Technician A Smith. The elapsed time between warning and airborne had to be four minutes.**

Malaya. The objective was to ensure a quick response to any strike against Northern Malaya, although really it gave the crews experience of reinforcing a Far Eastern station with minimal backup maintenance teams. This was intended give the teams self-reliance and experience of being an independently operating unit in a foreign land. It was also a backup for the RAF's 'Firedog' operations in Malaya but the Valiants were never used for active bombing operations; instead they flew sorties over the Song Song bombing range.

To illustrate just how much testing is needed to clear a new aircraft type for service, on 6th March 1956 Vickers were using the following Valiants for Air Ministry or in-house testing:

WB215 Super Sprite;
WP205 Test after repair, day role photo-reconnaissance tests;
WP208 Autopilot, de-icing, window, auto-stabiliser, bomb bay buffet, power controls, cockpit lighting;
WP210 Controls, performance, vortex generators, engines, handling, electric inverter cooling, power controls;
WZ375 Flight tests for RAE and A&AEE;
WZ376 Flight refuelling probe, vibration etc.

By the week ending 23rd July 1956, Vickers' Valiant programmes included generator trials using WP204 (estimated programme cost £38,000), radio counter measures development and flight trials with WP214 (estimated expenditure £50,000) while WP199 and WP218 were serving as trial installation aircraft. Major development work still to be completed included tropical trials, Super Sprite rockets for production Valiants and water methanol on take-off.

The last production Valiant was XD875, a BK Mk.1 first flown on 27th August 1957 by 'Jock' Bryce and Brian Trubshaw. Within three days this aircraft was performing at the 1957 SBAC Air Show at Farnborough, after which it was delivered to 207 Squadron at RAF Marham on 24th September. By this time a total of eight squadrons were operating Valiants and all were currently in the UK: 7 and 90 Squadrons were at RAF Honington, 49 and 138 Squadrons at Wittering, 148, 297 and 214 Squadrons at Marham and 543 Squadron at Wyton. However, a ninth unit, 199 Squadron specialising in ECM, had begun receiving Valiants to replace its Canberras and Lincolns.

Valiant captains, second pilots (from 1955 called co-pilots) and navigators previously had to have flown in Canberras and all V-Bomber crews had to be very experienced; captains had to be rated 'above average' and to have logged at least 1,750 hours as a first pilot. In general the aircrew liked the aircraft because it handled well without any vices and did not have any complex procedures. Engines were started in order 3-2-1-4 (later all were started together) and at maximum overload weight of 175,000lb (79,380kg) the take-off would be made at 140 knots (267km/h); lower weights meant lower take-off speeds. A typical climb would be made at 250 knots (463km/h) until the height was reached where this equalled Mach 0.73; the climb would them continue at the aircraft's cruise speed of Mach 0.75.

Many training sorties would be flown by Valiant crews and a typical trip might involve a four-hour plus flight across country with several simulated radar bombing attacks against 'targets'. John Lewer, who was the last Navigator Radar to go operational on the Valiant before it was grounded, remembers that the Valiant gave a smoother ride and was nicer to fly in than the Vulcan. It was easier to get in because it had a side door rather than the Vulcan's deep well and the flight deck inside seemed quieter. Heard from the ground the Valiant at low level seemed to whistle by rather than making the heavier noise associated with the Vulcan. He felt the Valiant's only weakness was the NBS which was the same on the Vulcan and Victor and comprised the World War

-2S plus an analogue computer. This system was accurate to 400 yards (366m), which was fine for a nuclear weapon unless the target terrain was hilly; if the bomb landed on the wrong side of the hill the target could be shielded from the shock wave. In addition NBS serviceability was not too good.

In February 1956 WZ375 received some special instrumentation for high-speed flight trials before Vickers flew it to Boscombe Down on the 16th; Vickers had also fitted strengthening to the ailerons, elevators and rudder. A total of eighteen and a half hours of high-speed flight was undertaken in the region of 30,000ft (9,144m), but on the last flight the rudder balance tab failed with the upper portion of the tab coming away from the aircraft. The fin suffered some skin damage and minor damage was received by the ailerons, but the elevators were unaffected. An investigation to prevent such damage recurring under continuous flying in the buffet region was urgently pursued but WZ375 was refitted with standard control surfaces before returning to A&AEE.

Also early in 1956, Bomber Command was invited by the USAF Strategic Air Command (SAC) to send observers and a Vickers Valiant to participate in its annual bombing competition against the very best crews from the USAF. Valiant WZ397, Wg Cdr L H Trent VC DFC and the Senior Air Staff Officer of Bomber Command (AVM S O Bufton CB DFC) formed the team that was selected to go and appraise the situation and their report stated that 'only concentrated training would enable our crews to score results good enough to place us in the top half of the table'. On 2nd September WZ397 returned to Marham non-stop from Loring AFB in Maine in 6 hours and 15 minutes.

Following Bomber Command's own competition in June 1957, which Wg Cdr Oakley won in a Valiant, the Command was invited to enter the 1957 SAC Competition to be held at Pinecastle in Florida and four RAF crews commenced training. These comprised a team of two Vickers Valiant crews and two Avro Vulcan crews representing 3 and 1 Groups respectively. Group Captain J Woodroffe was responsible for the training of the four nominated crews and he had Wg Cdr Oakley and Flt Lt Mather from 138 Squadron, and Sqn Ldr Payne and Flt Lt Price from 214 Squadron, as the captains of the four aircraft but sadly, during the training programme, Gp Capt Woodroffe was killed in a flying accident at Pinecastle with the Base Commander Col M N W McCoy. Five Valiants actually went to the USA: XD858 which flew out on 22nd October, XD859, XD860 and XD861 on 25th, and XD868 which departed on 18th October with some spare parts.

The competition began on 30th October 1957 and 90 aircraft took part: 66 Boeing B-47s, ten Boeing B-52s, ten Convair B-36s plus the two Valiants and two Vulcans; Flt Lt Mather flew on the first night, Sqn Ldr Payne on the second. On their second flights Mather's performance was 'average' but Payne had a magnificent night in both bombing and navigation, going from 47th overall to 12th in the individual crew classification. On their last night's flying Payne had another excellent result but Mather fell off badly, the team finishing 27th out of 45 with, individually, Mather 76th out of 90 and Payne an exceedingly good 11th. It must be remembered that the British crews were bat-

Top **Take-off shot of XD858.** Phil Butler collection

Right **A USAF inspection of XD861 which brought to the American's attention the knowledge that the UK could still produce very potent warplanes.**

Left: **The 148 Squadron Valiant crew that achieved 9th place out of 164 competing crews at the SAC Bombing Competition held at March AFB, California, in October 1958. Left to right: Sqn Ldr R W Richardson AFC and Flt Lts D C Rigby, T C Taylor, D C Edwards and J J Denn.**

Photographs on the opposite page:

Top: **Excellent view of XD819 with everything down during a slow-speed fly-by, believed to be at Farnborough in the late 1950s.**

Bottom: **Delightful air-to-air view of BK Mk.1 XD861.** Phil Butler collection

ting on 'enemy' territory when the opposition teams had practised the same exercise many times over and knew the territory well; our equipment was also untried and not fully tested in battle conditions. Subsequent analysis showed that there was only a few yards in the bombing accuracy and a quarter of an inch (6.4mm) in navigation accuracy, yet the British press reported it as a poor show; as usual they were talking without knowing any background at all.

A Valiant detachment participated in another SAC Competition in 1958 at March Air Force Base in California. This took place between 13th and 18th October and the aircraft involved, XD819, XD859, XD861, XD873, XD874 and XD875 departed for America on 10th September. This time, out of the 41 competing wings, the RAF 'B' team of Valiants gained 7th place in the B-52 class, in combined bombing and navigation. One crew led by Sqn Ldr R W Richardson of 148 Squadron achieved 9th place out of 164 competing crews and scored 1,379.7 points against the winner's 1,520 points.

Crews were placed individually and Wg Cdr S Baker (CO 138 Squadron) came 12th and Wg Cdr F C D Wright (CO 148 Squadron) 30th, a remarkable achievement with the odds stacked against them. The Americans had 140 SAC crews in this competition, four from each of 35 bases, whilst the RAF had just the four teams altogether and again the Americans were on home ground. The competitors had to fly the same route taking in three targets followed by an astro-navigation leg of approximately 950 miles (1,529km). What was particularly satisfying was that the UK team's serviceability record for the competition was much better than any of the American teams, with no airframe or engine faults whatsoever.

One result of the Valiant doing so well in SAC's competitions was that General Curtis LeMay, the Head of SAC, led a USAF team that visited Weybridge to examine the Valiant more closely and they were particularly impressed by its take-off performance. The RAF did not participate in the 1959 competition, when flight refuelling was introduced, or in 1960 when low altitude navigation and ECM activity were another new feature. However, Bomber Command did hold its own annual competitions between 3 Group Valiants (and later Victors) and the Vulcans of 1 Group. The exacting event would normally last three days and each participating crew would be accompanied by an umpire.

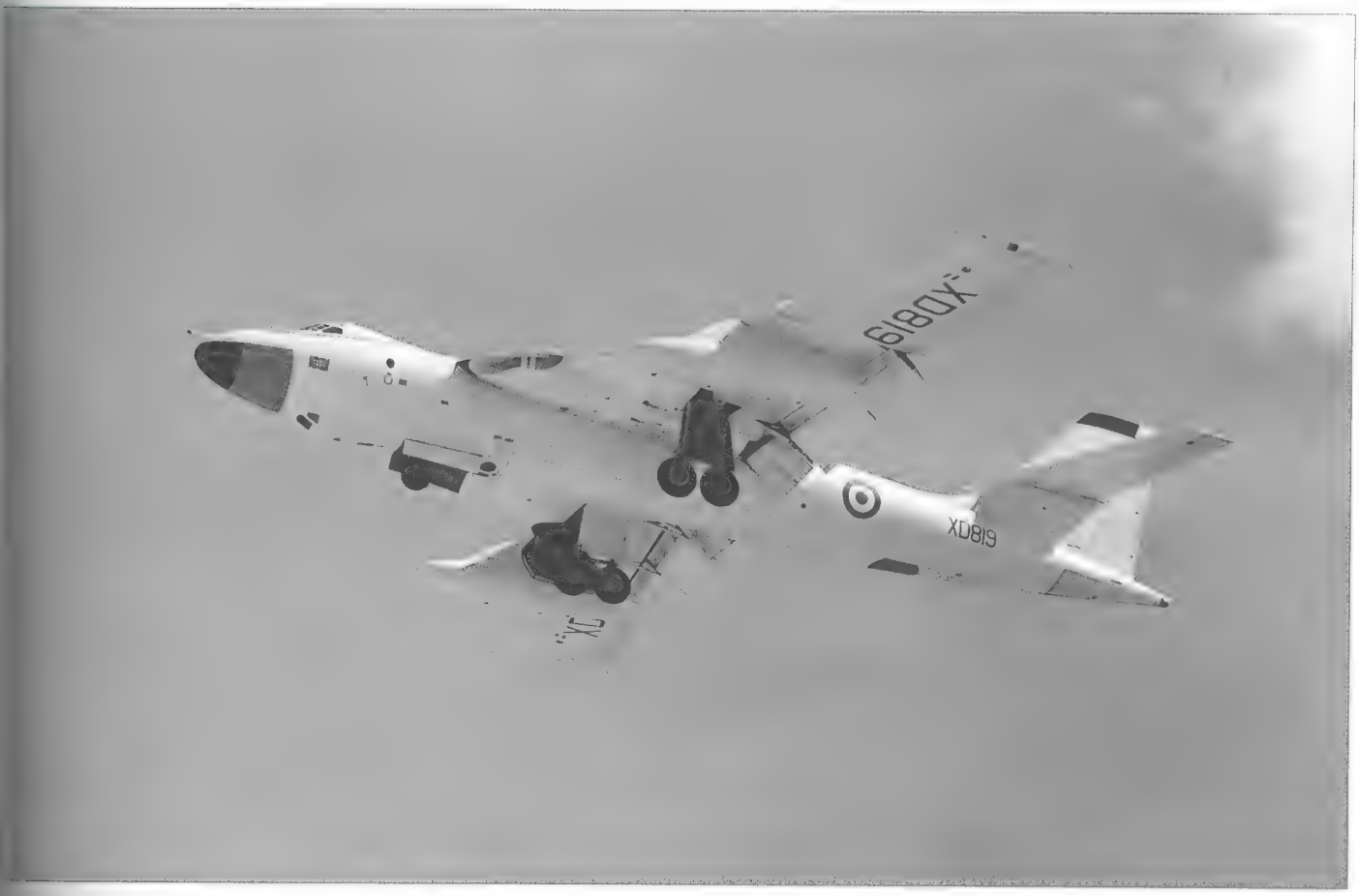
We shall see shortly that late in its career the Valiant had to switch to low-level operations; however, much earlier, WZ383 had been used to assess the type for low-altitude flight at high speed. It was specially modified with stress gauges, accelerometers and their associated equipment to find out just how much flexing of the aircraft structure occurred in the powerful gusts that were so common at low altitudes, especially near the ground.

Between 2nd and 16th March 1956, WZ383 flew eight flights with Vickers' pilots totaling 16 hours 35 minutes (the time for a ninth flight is unknown) and on the later trips they were accompanied by A&AEE pilots. These flights varied in duration from 55 minutes to 2 hours 50 minutes and were flown over three different routes extending across the greater portion of the British Isles. Weather conditions varied from very good to poor to atrocious with low cloud (in one case visibility went down to 2,000 yards [1,829m]) while the levels of turbulence varied from very slight to severe. Speeds of 320 knots (593km/h) were achieved for considerable periods and the height above the ground varied between 50ft (15.2m) and 250ft (76.2m). The results showed that high-speed low-level flights were indeed possible with the Valiant.

However, the rough bumpy air conditions and the unusual character of the operations did give considerable pilot fatigue on the initial flights but the pilots reported that later on, with experience, they found that this could be reduced, which made the flying easier. As expected, the control forces required to fly the aircraft were high but after six flights the aileron and elevator artificial feel were reduced by about 50%, a change which afforded the pilots considerable relief. The view from the pilots' positions was considered to be adequate but not ideal for this type of operation. The flights were made in the cold conditions of March and cabin temperature and humidity conditions were considered satisfactory, but one report says that under hotter ambient conditions improvements in cabin cooling and a means to deal with condensed water would be necessary. Vickers began dealing with this last point immediately.

With the reduced feel the maximum loads which could be applied by the pilot at high speeds and low altitude were still within the designed strengths of the components but at high Mach number speeds it would be possible for the pilot to apply excessive loads. It was felt that if a low-altitude role for the Valiant was required (which it was in the 1960s), or if the aircraft had to be restricted to low altitude operations over the full height range, then a variable feel control operated by the pilot may be required.

WZ383 was also modified with a metal nose fairing in place of the nose radome to avoid any interruptions from the possible erosion of the radome surfaces. Metal debris guards were also fitted in the air intake for the two inboard engines and one seagull did enter No.3 engine's intake and was caught by the debris guard. The pilots reported that several near misses of bird impact occurred during these flights, especially when overtaking birds, so it was proposed to retain the debris guards for the next series of flights to enable a further assessment to be made of the risk of engine failure due to bird impact.


XD819
XD819


XD861
XD861

Left: **WZ368 flew 1,200 hours with 232 OCU at Gaydon.**

Photographs on the opposite page:

Top: **A line of Valiants at an SBAC Show in the late 1950s. A mass 'scramble' by V-Bomber crews was usually a Farnborough highlight but here XD874, XD817, XD819 and WZ395 waiting to go remind one of the Le Mans 24 Hour race.**

Centre: **The four aircraft finally get away during their Farnborough mass 'scramble'.**

Bottom: **General Lyman L Lemnitzer, Supreme Allied Commander, Europe, visited Scampton on 9th August 1963 where he inspected the missile servicing and storage bay for Blue Steel plus Victor, Vulcan, Canberra and, here, a line of Valiant aircraft.** Tony Buttler collection

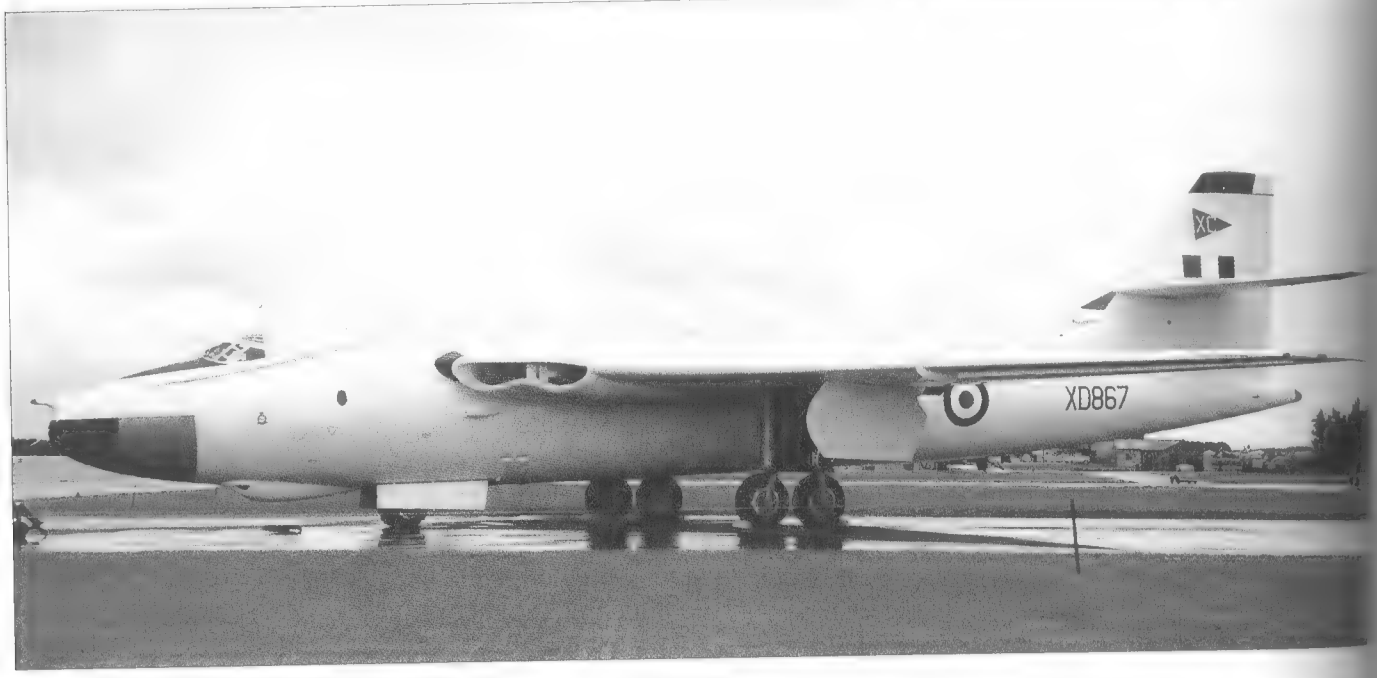
It was expected that air turbulence at low altitude would seriously reduce the safe fatigue life of the main aircraft structure and in order to investigate this matter strain range counters were fitted to the front and rear main spars from the start of the operation, and an accelerometer was installed in the standard position adjacent to the bomb cell. Analysis of their recordings showed that very large numbers of gust loads were applied in just a few hours flying and from this data Vickers recommended a safe life in the region of only 75 flying hours. The company also wanted the aircraft's mainplanes to be removed after the safe flying hour limit had elapsed in order to subject them to repeated load tests. After so few test flights it was difficult to estimate the probable safe life of the Valiant's wings if the aircraft were used in the low-level role, but the indications were that it would not exceed 400 hours under the most favourable conditions and the real figure might well be less than 200 hours.

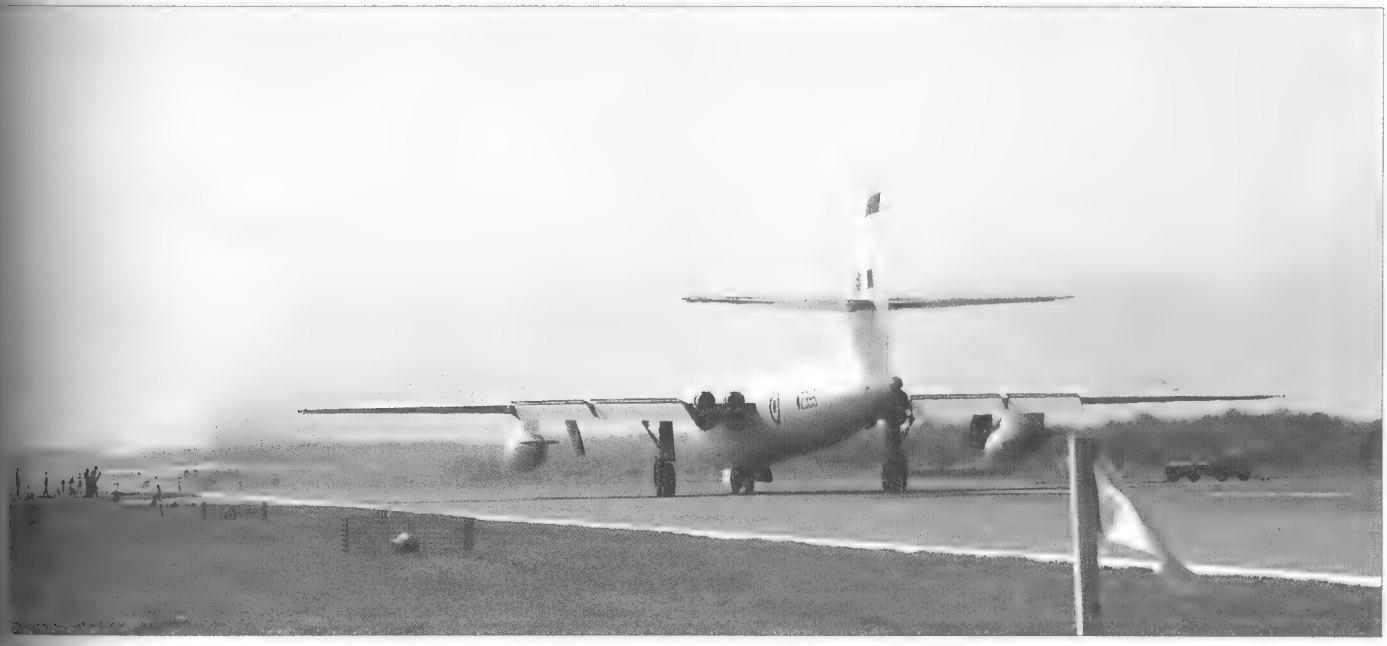
Below: **XD867 at rest on a good old English summer's day – grey and wet.**

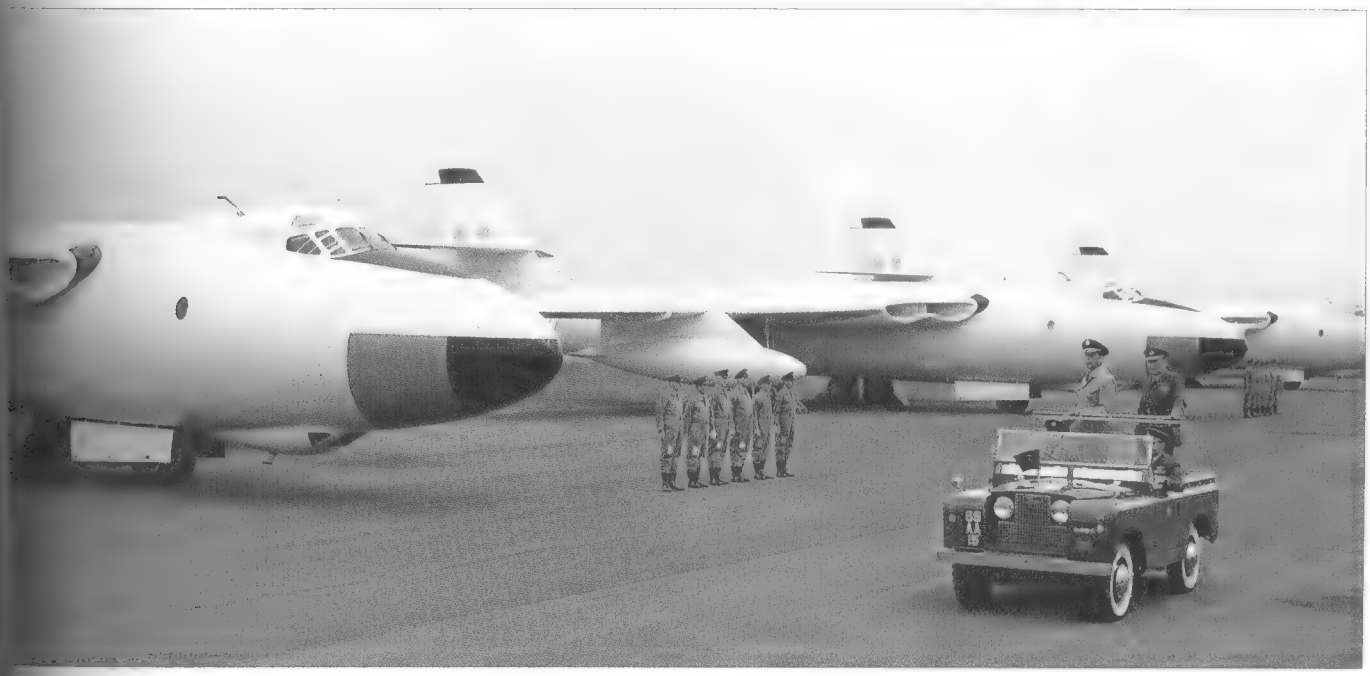
At the end of 1960 nine squadrons and an OCU still used the type. When they were developed, the V-Bombers were able to bomb from high altitudes of around 50,000ft (15,240m) with comparative security and then return safely, but the development of much more advanced air-to-air and surface-to-air guided weapons threatened the safety of high-altitude bombers. With missiles now capable of reaching bombers flying at high altitude, the Air Ministry concluded that the V-Bombers must switch to low level. Because the Valiant lacked jamming capability, bar 'Window', it needed the extra security of flying at low altitude more than the other V-Bombers and so was the first type to make the switch. The arrival of Mk.2 Vulcans and Victors had also reduced the need for Valiants in their original role, with the result that some could now be assigned to NATO to replace Canberras and in the process they received nuclear stores specifically designed for low-level operation.

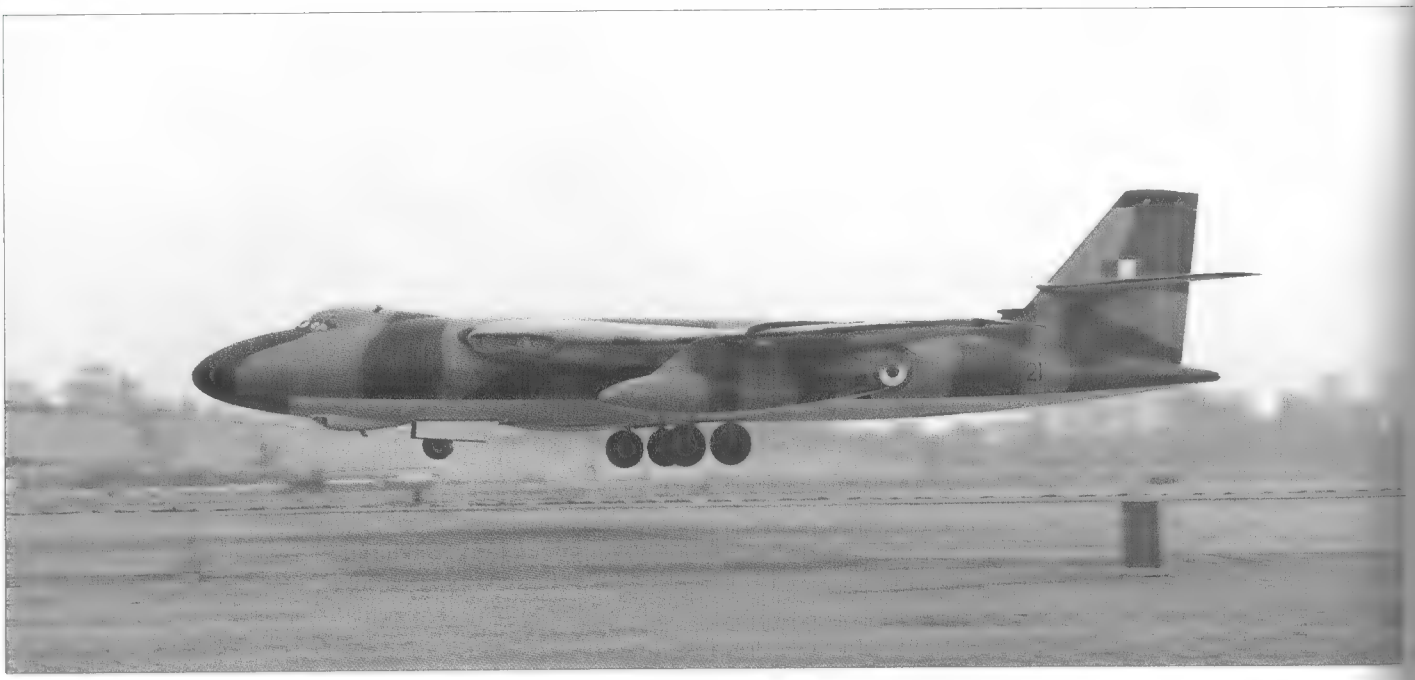
Three Valiant squadrons, 49, 148 and 207, were assigned to NATO's Supreme Allied Commander, Europe, (SACEUR) in 1960 and 1961 and became the Valiant Tactical Bomber Force. They could carry the British Red Beard or American Mk.28 or Mk.43 tactical nuclear weapons or standard 1,000 lb (454kg) bombs and became operational between August 1962 and April 1963. The Mk.28 was to be delivered from 45,000ft (13,716m) but the Mk.43 was introduced in 1963 for low-level dropping as the squadrons converted to the new role. From January 1962 each squadron was expected to have four aircraft on 15-minute standby, a step that gave birth to the Quick Reaction Alert (QRA).

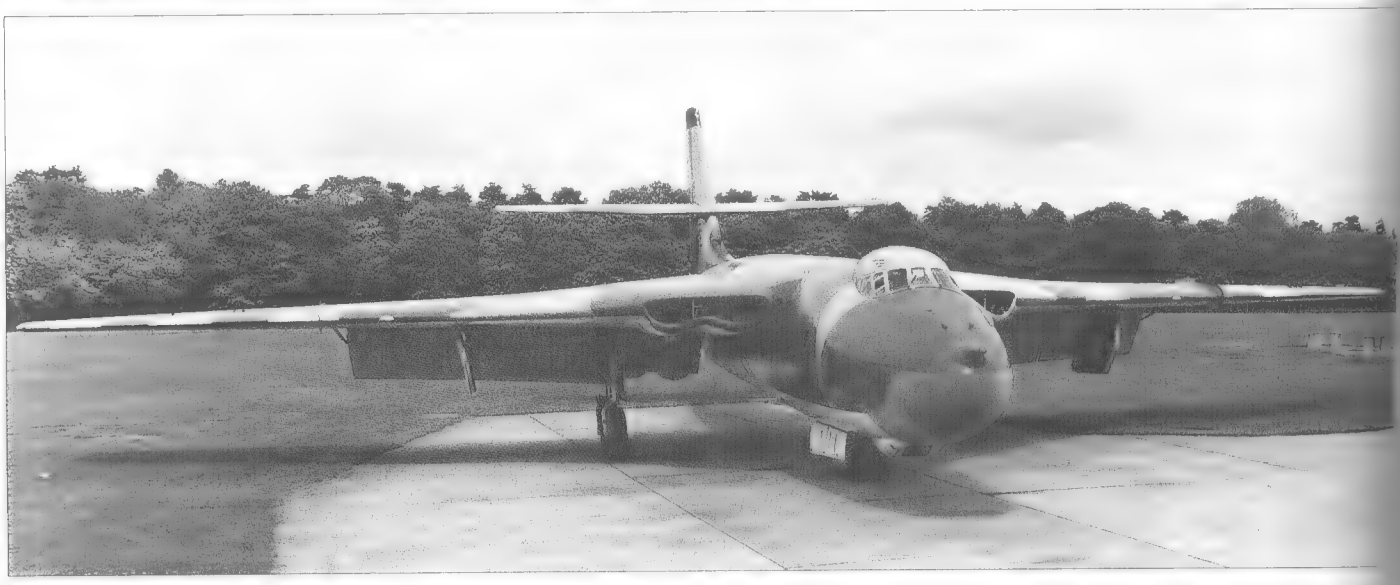
Special hardstandings were built at Marham next to the runway thresholds with the aircraft in position, and crew accommodation nearby so that all four could be in the air inside the allowed four minutes. The three squadrons formed the Marham Wing and offered a better service than the Canberra aircraft they replaced because the latter were still using Gee-H for navigation (Gee-H's accuracy deteriorated with increases in distance). The low-level strategy was to fly at a height which gave the Valiant its best fuel consumption until the aircraft was











within 100 miles (161km) or so of the target, then drop to low level to get underneath the enemy's radar, drop the weapon and fly out at low altitude for some distance before climbing back to height for the return home.

This move brought other changes with it, the first being that all Valiants had to be painted in low-level green-grey camouflage rather than the normal brilliant white finish, which was too distinctive. The Air Ministry issued the appropriate authority to all aircraft manufacturers on 5th September 1963 and Vickers selected WZ403 as the first Valiant to receive the new camouflage. Modification number 3261 covered this repaint and WZ403 received its new livery at RAF St Athan, but on inspection on 21st June 1964 the result was considered unsatisfactory so the final pattern had to be changed slightly. Back in 1962 an awareness exercise called 'Kinsman' had been carried out to peak up the response time of the aircraft and their crews and get them in the air in as short a time as possible.

Also in 1962 a project was initiated by Vickers for the installation of a cargo pannier in a Valiant's bomb bay. The pannier was designed to take a 4,000 lb (1,814kg) load and the idea was that the aircraft could take its own ground equipment on an overseas trip. Marshalls Flying School got the job of building, stressing and passing the pannier for service and the aircraft selected for the modification was XD863. The work involved making a 124in (315cm) by 59in (150cm) rectangular metal framework that would fit into the rear end of the bomb bay so that the pannier could then be fastened onto it using four quick-release bolts. XD863 made its first test flights with the new fittings on 12th and 13th June 1962; no faults were discovered and the installation was passed as safe to use.

As the numbers of Vulcan and Victor aircraft in service built up, so the Valiant force was reduced and during 1962 and 1963 three other squadrons, 7, 18 and 138, were disbanded. In September 1962 7 Squadron's active life ended in explosive form when it dropped live sticks of 1,000 lb (454kg) bombs on Salisbury Plain as part of a demonstration for senior NATO officers. In February 1964 it was revealed that the V-Force had hit its operational peak with 159 aircraft on strength which still included 50 Valiants.

The Valiant was a faithful servant but in mid-1964 some aircraft were found to have slight fatigue cracks in the front and rear wing spars. While carrying out repairs to a Vickers Viscount aircraft damaged in an accident, an unrelated crack was found at a spar bolt hole. Both Viscount and Valiant used the same spar material (DTD683/RR.77 aluminium alloy) so the spars of both types were examined and when the entire Valiant fleet was checked, several more were also found to have cracks.

On 6th August Valiant WP217 from 232 OCU at Gaydon suffered a rear spar failure during a high-speed flight over North Wales at about 40,000ft (12,192m), a big bang followed by vibration being heard and felt by the crew. The captain was under instruction by a type rating instructor and examiner and it was agreed that the aircraft should be flown carefully back to Gaydon. WP217 was then found to be suffering asymmetric flap (the flap controls had been severed on one side) but a successful flapless landing was eventually achieved. The aircraft looked terrible – the skins over the starboard wing roots and inner wing were rippled, rivets were missing and, looking towards WP217 from in front of the nose, it could be seen that the wing tips were about 2ft (61cm) out of alignment. It was indeed fortunate that the Valiant was a multi-spar aircraft; a single-spar type would have been lost.

Opposite page, top: **Valiant B(PR) Mk.1 WP221 comes in to land during 1964 resplendent in its new low-level camouflage.**

Opposite page, centre and bottom: **Camouflaged Valiant BK Mk.1 XD825 shows off its huge landing flaps at Wisley during 1964. In 1966 this aircraft was allocated maintenance serial number 7873M for use as an instructional airframe.**

Below: **Because Vickers had resparred XD816 in an exercise to investigate the feasibility of resparring the whole Valiant fleet, this aircraft was kept in service and became the last example to fly. One of its final appearances came on 29th April 1968 at Bomber Command's final flypast at Scampton, the day that Bomber Command and Fighter Command were merged to form the new RAF Strike Command. This view was taken at Wisley in May 1967 when the aircraft was involved in a Ministry of Aviation/Ministry of Technology fatigue trials programme, which was completed the following April.**

In June 1968 XD816 flew its last public display at Abingdon and is seen on arrival back at Wisley.

Inspection revealed that it was the lower rear spar boom on the starboard side that had failed but WP217 had flown just 2,330 hours which was calculated to be only 55% of its fatigue life. Meetings were held at Weybridge on 12th August and St Giles' Court on 17th where it was agreed that each Valiant's spars and flying hours should be thoroughly examined by Vickers and the aircraft categorised according to its general airworthiness. No cracks, or small cracks only, and a particular aircraft could continue some restricted flying; anything worse and it was grounded. This was a major job and kept Vickers tremendously busy. Incidentally, a Valiant spar was very difficult to test with standard ultrasonic crack detection equipment because it was completely encased within the wing (the Viscount's was rather easier), but the crack problem brought forward a new type of special ultrasonic probe which made the task much easier. This prevented the Air Staff from having to decide whether or not to keep individual aircraft flying and thus run the risk of a catastrophic in-flight failure.

By the beginning of October the firm could categorise the whole fleet as follows:

Category A: fit to fly;
Category B: grounded for viable repairs;
Category C: grounded with a possibility of being Struck Off Charge.

Each flyable airframe was 'fatigue indexed' very closely and if the combined figure came below a certain limit, then that particular aircraft could continue flying; once the figure was passed, it was grounded. Twelve were cleared to fly, 19 were available to fly only in a national emergency and five were grounded; for flight banking was limited to 30°, speed to 250 knots (463km/h) IAS and 'g' loads to 0.5 only. This was a real disaster and all aircrews had their flying drastically reduced but the full commitment to SACEUR was maintained.

It was hoped that repairs could be effected with a simple modification but after the wings on two airframes were ripped open at 19 Maintenance Unit at St Athan, subsequent examination of the spars showed that the fatigue problem was severe and serious. On 9th December 1964, all Valiants were grounded and that day XD818 flew its last training flight. It was thought that low-level work might have extended the Valiant's service career by several years but it was never designed to cope with the violent loads exerted on the airframe by low-level flying. In addition the flight refuelling Valiants were also found to be affected so a theory that the problem was confined just to the bombers had also proved to be incorrect.

Vickers had known about and examined the potential fatigue problem before 1964 and resparred XD816 in an exercise to investigate the feasibility of resparring the whole fleet. The firm found that the cost was prohibitive and the Air Ministry turned it down flat so, from 26th January 1965 onwards, the Valiants were basically scrapped where they had landed, most of them at their home RAF stations. For the seven weeks prior to this SACEUR aircraft were kept on strength but not flown.

A meeting held at Weybridge on 4th February between Vickers (now part of the British Aircraft Corporation), the Ministry of Aviation and RAE, with Gp Capt C S Pattison as chairman discussed the official declaration to withdraw the Valiant from RAF service. BAC expressed concern at the manner in which the office news of the withdrawal had been made public (on the radio etc) without a corresponding notification to the company. The starboard outer wing lower spar booms from WZ396 were to be transferred to RAE for analysis and in due course five Valiants, including XD818, were retained to complete some test work. The rest however were destroyed, a very sad and sudden end to an aircraft that the crews had said was a delight to fly. It was one of the few types looked on with affection by all who flew it, all the more remarkable when one considers that the Valiant was also a pioneer aircraft in so many ways. Fortunately XD818 was held at Marham as a gate guard until it was moved to the RAF Museum at Hendon, where it is still located today.

From a British point of view the loss of the Valiant was perhaps not desperate because the type had begun to be looked upon as rather elderly. But SACEUR felt their loss much more deeply because they were the only aircraft they had capable of giving a long-range punch and they left quite a gap in NATO's resources. The then Defence Minister, Denis Healey, has said that the withdrawal caused 'considerable embarrassment for us with our NATO allies.

Service Career
Britain's Nuclear Deterrent

The V-Bomber's primary RAF role was to deliver Britain's atomic bomb. It is not the objective of this book to go into the background of our nuclear deterrent in depth but rather to describe the Valiant's role in it and to show what it accomplished testing various nuclear devices. In fact the Valiant was the only British type to actually drop some of Britain's nuclear stores.

In August 1946 the American Senator McMahon proposed the Atomic Energy Act which stated that the transfer of any nuclear information to any foreign country was illegal under penalty of imprisonment or even death. This meant that the Americans, having now exploded their first atomic bombs, had spurned the UK and refused us access to their technology. This step was taken by the Americans after the discovery in 1946 that Alan Nunn May, a British scientist working on Allied atomic weapons, was a Soviet spy.) Back in Britain Clement Attlee had just become Prime Minister and his Labour government was committed to maintaining Britain's status as a major power. It regarded the development of an independent atomic capability as vital to the UK's world standing and this conviction was reinforced by the passage of the McMahon Act by the US Congress on 6th November which halted US and UK co-operation in this field.

In January 1947 Attlee's government formally committed the UK to the development of an independent atomic weapon. The country's first atom bomb was called Blue Danube and had a nominal yield of 20kt and was contained inside a casing derived from the conventional 12,000 lb (9,072kg) Tallboy bomb. The value of this independent stance was revealed in 1949 when the Soviet Union exploded its first nuclear device, and then in 1950 North Korea invaded South Korea which put both the USA and the UK back on a war footing.

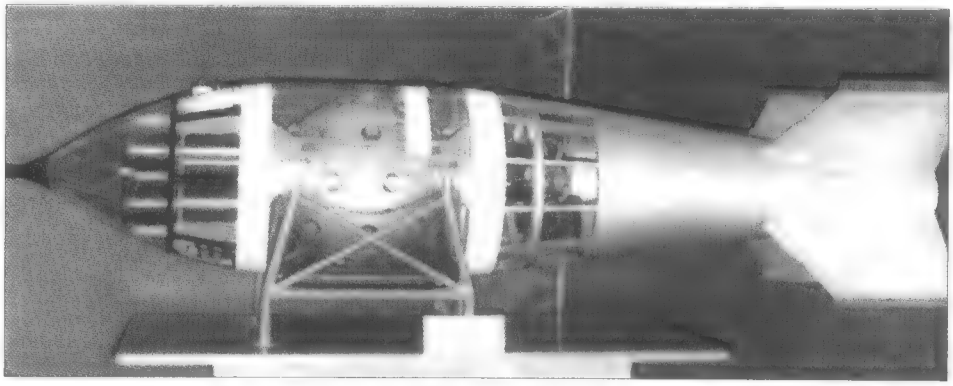
The following live tests were planned to confirm the estimated yield and effect of British nuclear devices:

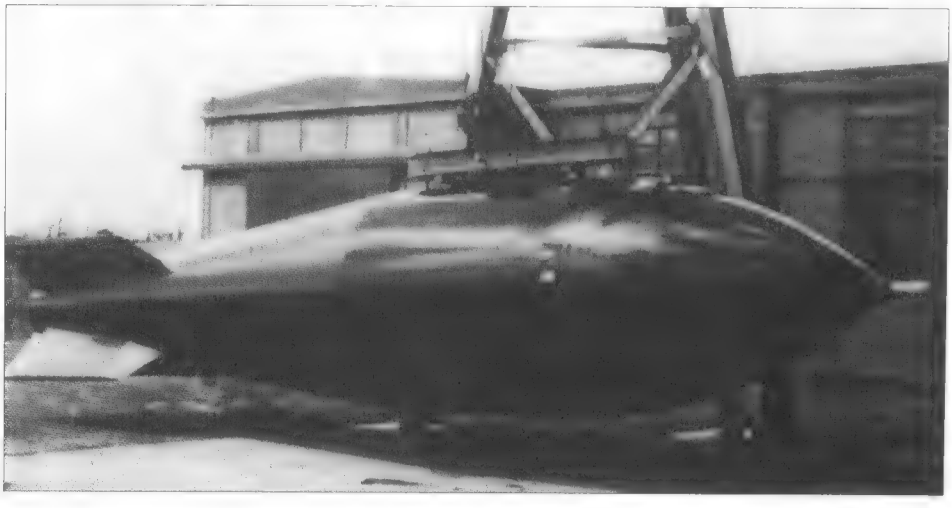
a. Operation 'Mosaic' was to be a ground detonation at Monte Bello in May 1956 of the prototype Mark I weapon;
b. Operation 'Buffalo' would be the first air drop, from a Valiant bomber, at Maralinga in Australia between July and November 1956;
c. These would be followed by Operation 'Green Bamboo', later renamed 'Gazette' in 1956 and then Operation 'Grapple', that would cover air dropping of thermonuclear devices (hydrogen bombs) in the South Pacific during 1957.

Such was the secret nature of this project that it received many different codenames to help cover things up. Even Grapple's backup equipment was coded, for example 'Grapple Cokes' covered trade pack goods sent to the Senior Equipment Officer at RAF Wittering and 'Grapple Dulse' the full tropical pack sent by Vickers to the Officer Commanding 3 MU at RAF Milton in Berkshire. Support units for these exercises would include 76 Squadron with Canberra B Mk.6s at Edinburgh Field, a squadron of Vickers Varsity aircraft that would accompany 76 Squadron for 'Mosaic' and 'Buffalo' only and 100 Squadron (Canberras) for 'Grapple'. Valiants from 49 Squadron were to be used for the airborne drops.

From August 1954 1321 Flight, commanded by Sqn Ldr D Roberts DFC AFC, began to build up experience in carrying and dropping inert 10,000 lb (4,536kg) 'special' bombs on the Orfordness bombing range so that the Valiant crews could be brought to full readiness for Operation 'Buffalo'. The 'bombs' were ballasted to replicate the same weight and characteristics of the real weapon. Prior to this, dropping trials of experimental aerodynamic bomb shapes had been made using the Short Sperrin prototypes. By May 1955 the Flight had three Valiants on strength which between them dropped 14 inert 10,000 lb stores over Orfordness between 15th June and 25th November. On 15th March 1956 1321 Flight was reformed as 49 Squadron.

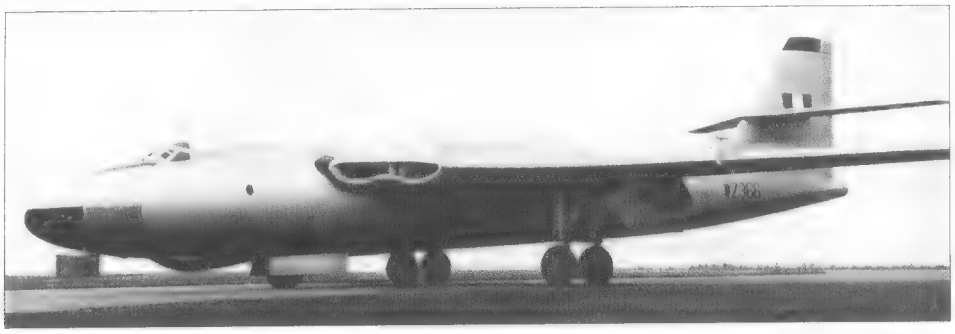
Two Valiant B Mk.1s, WZ366 and WZ367, were specially modified on the production line to 'Buffalo' standards for atomic bomb testing and were delivered directly to 49 Squadron at

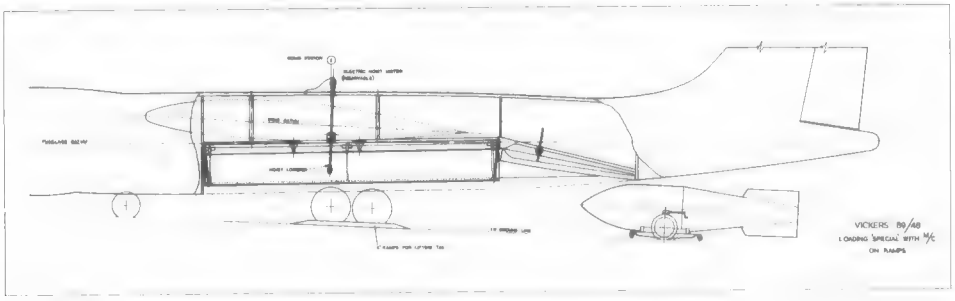




Blue Danube free-fall nuclear bomb. The 5ft (1.52m) diameter ball was the explosive part while the casing was 24ft (7.3m) long. Bomber collection

Illustration showing Blue Danube's huge size. This particular example was issued to Bomber Command's Armament School in November 1953. W Carter collection





Wittering on 14th and 16th May 1956. We have seen earlier the problems experienced releasing conventional high explosive bombs and this had to be fixed in time for the introduction of the aerodynamically shaped Blue Danube to ensure a smooth release. Consequently, an air spoiler made up of four vertical slats was fitted to the Valiant and extended just before release to break up the airflow and allow the bomb to fall instantly. Other special equipment included a Mk.10 autopilot, T Mk.4 bombsight, an accelerometer, a thermal recorder and a bhangmeter, the latter an instrument for monitoring nuclear explosions. In August the two Valiants flew to Edinburgh Field in South Australia to join their support units for Operation 'Buffalo'.

On 11th October 1956 the first British atomic bomb was dropped from WZ366, piloted by Sqn Ldr E J G Flavell with his crew of Gp Capt Menaul, Flt Lts Ledger and Stacey, Flg Off Spencer and Plt Off Ford, over the Maralinga test ground in Southern Australia. The Blue Danube casing, designed by RAE personnel, with the bomb inside was dropped from 30,000ft (9,144m) and Mach 0.8 at 1527 hours, the barometric fuse operated safely and the bomb exploded at 500ft (152m); a complete success. WZ367 flew 15 minutes behind to monitor and record the explosion. During the following May the first British air defence exercise to be based around a nuclear attack, called 'Vigilant', was held with Canberras, Valiants and USAF aircraft providing really stiff opposition for RAF fighters.

Operation 'Grapple' covered the dropping and proving of the British thermonuclear hydrogen (or H) bomb, which was more powerful than an atom bomb. Britain was a long way behind the USA and Soviet Union in H-bomb technology; the Americans exploded their first two thermonuclear devices at Eniwetok in November 1952 and the Russians followed suit on 12th August 1953. It was Winston Churchill, the then Prime Minister, who said on 1st December 1954 that we must have the hydrogen bomb and, fortunately, the following year discussions reopened with America on nuclear co-operation for defence purposes, which helped with the preparations of the British weapon.

It was decided that Christmas Island in the South Pacific could be used as a base for 'Grapple' hydrogen bomb test-drop aircraft and towards the end of 1955 it was surveyed to assess its suitability for the task, but plenty of work was needed to bring it up to a standard necessary to operate Valiants. The main servicing crews would live in tents but better accommodation was required for the servicing work itself to be carried out suitably protected from the elements. The bombers would be required to fly at a specific height and speed and after release they would have to make a steep turn to clear the target, manoeuvres that would take the Valiant to its limits. The bomb would detonate barometrically over Malden Island at 15,000ft (4,572m).

A very important item on the base was the provision of meteorological facilities to forecast when conditions would be acceptable to release the bombs. The bombs would be dropped in the vicinity of Malden Island approximately 400 miles (644km) south of Christmas Island, and with all the planned safety precautions it was expected that these air bursts would not produce any heavy fallout. Two Canberra PR Mk.7s fitted with special filter equipment joined the support fleet to collect radioactive samples and fly them back to Britain for analysis.

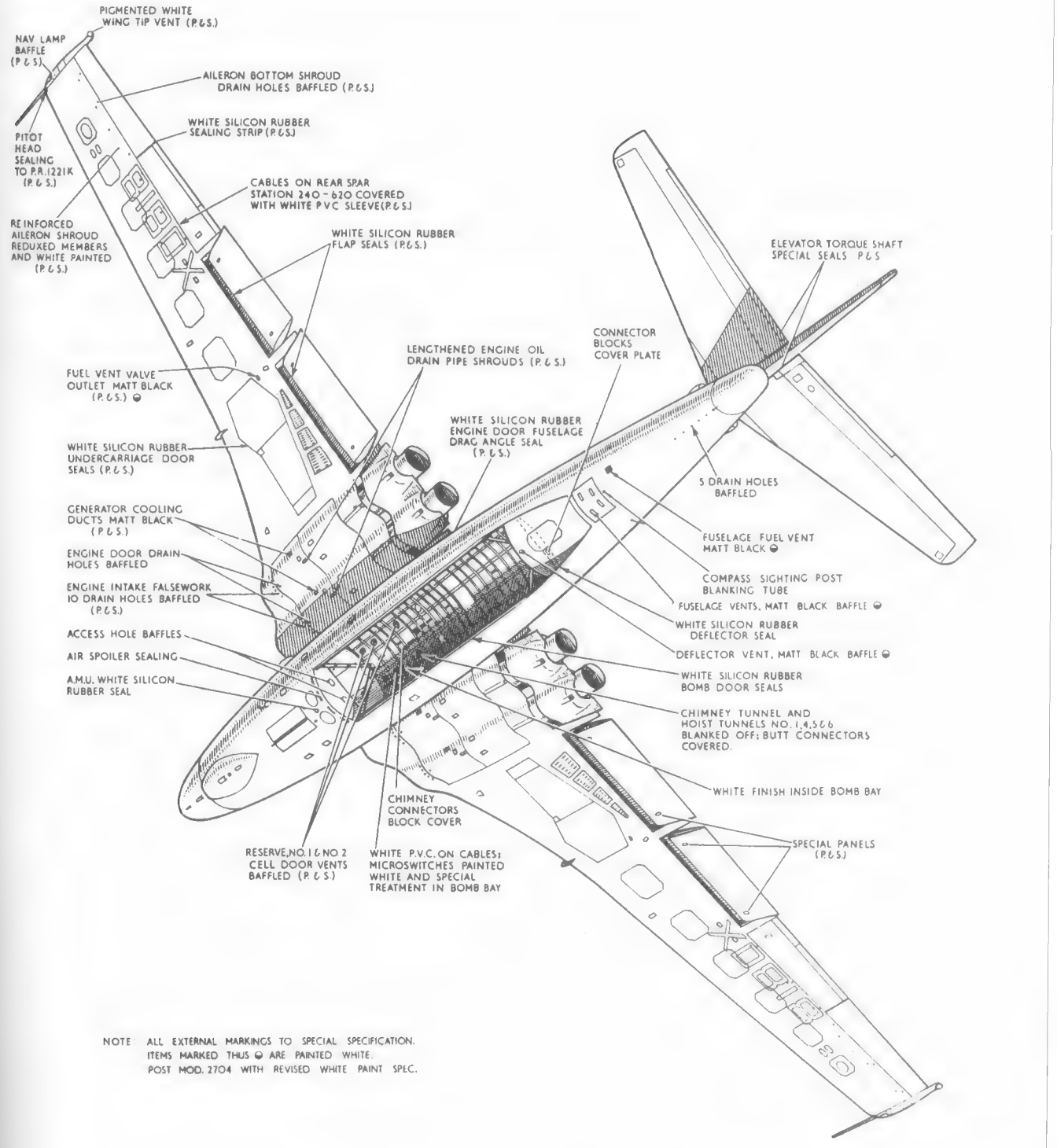
Eight aircraft (XD818, XD822, XD823, XD824, XD825, XD827, XD829 and XD857) were selected to be specially adapted on the Vickers production line for this major operation (under Vickers modification 2154). Each aircraft's nose radome was replaced with a metal nose fairing and the standard tail cone by a new version containing special instruments. All aerials fitted with Bakelite or composite were specially treated including the ILS aerial at the wing tips, the VHF aerial on top of the fin, the HF aerial in the port wing root, the dummy fairing in the starboard wing root, the Rebecca in the nose fairing and the radio compass loop on top of the fuselage; there were about 250 modifications in all.

Top: **WZ366, the aircraft that dropped the first British atomic bomb.**

Centre: **Drawing showing a Valiant fitted with Blue Danube (drawing 65537 Sheet 8).**

Bottom: **49 Squadron Valiant crews at Maralinga. Sqn Ldr Flavell is in the centre of the back row.**

Opposite page: **Drawing of XD818 showing some of the special precautions given to the aircraft at the factory for its 'Grapple' sorties.**



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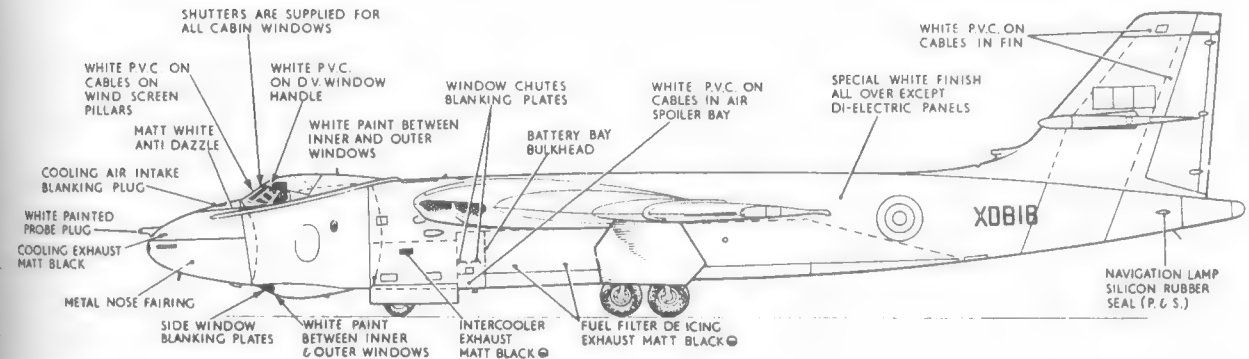
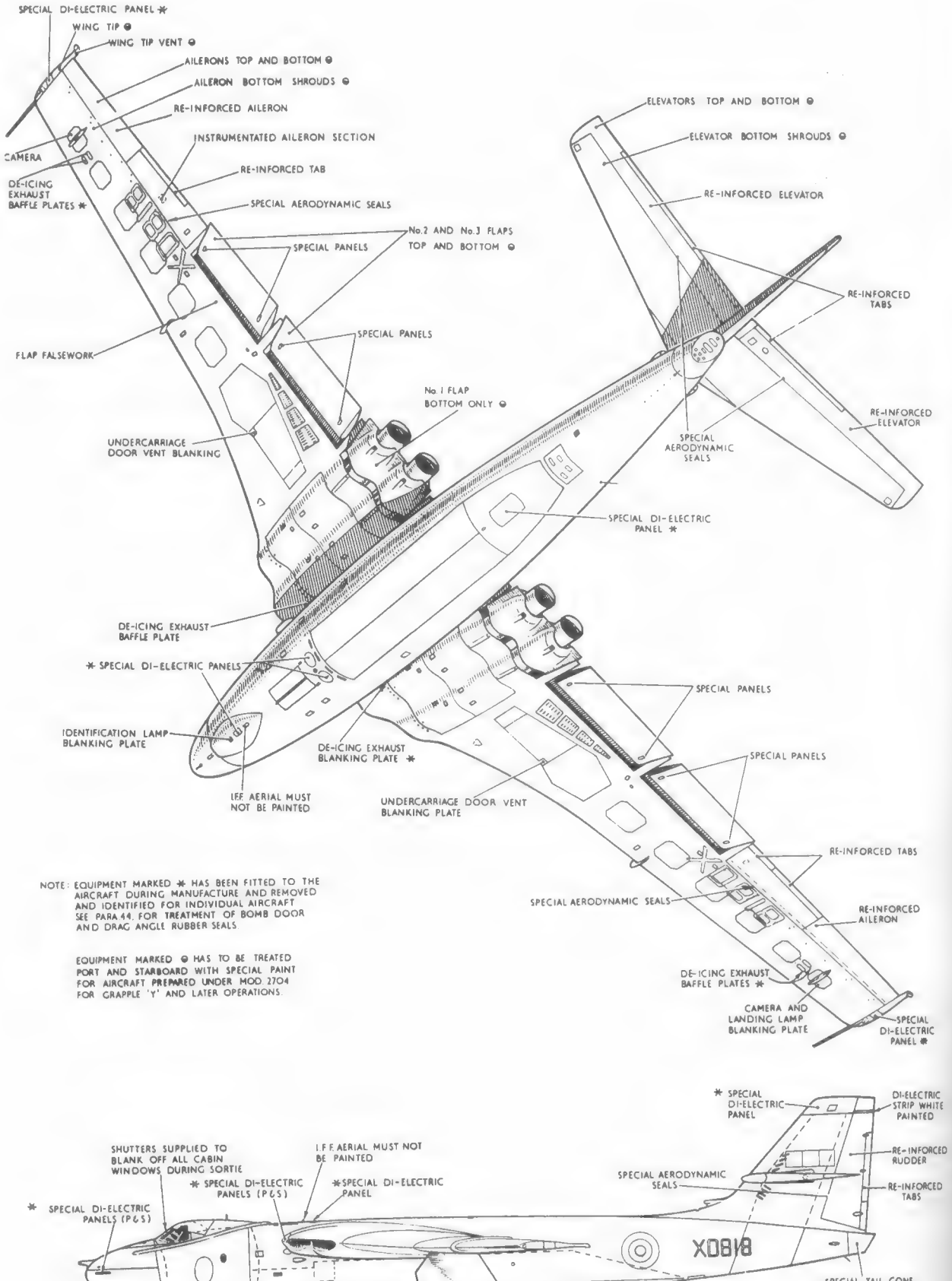
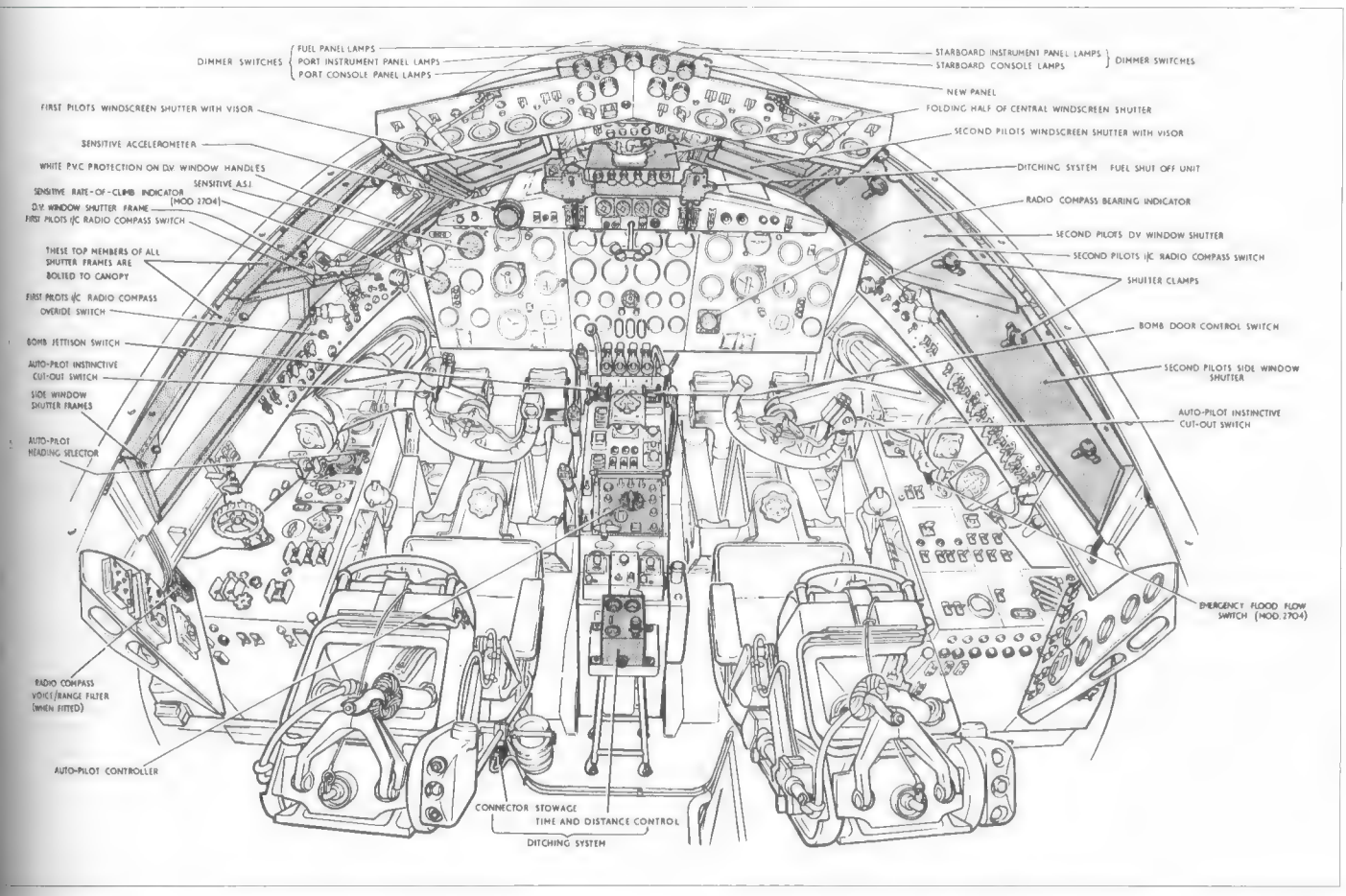






Above: **Modified cockpit of the 'Grapple' Valiants, including the window shutters.**

Opposite: **XD818 illustration showing additional special precautions added for the tests.**

A vital change was the installation of metal anti-flash screens or shutters on all of the cockpit windows, seven altogether, to protect the crew. Various pieces of equipment inside the aircraft were also screened as far as possible against the bomb's radiation and the control surfaces were strengthened to take into account the pressure waves generated by the bomb. Pressure sensors and cameras were amongst the items fitted to observe the tests.

All aircraft were coated in white highly reflective cellulose anti-flash paint in order to reflect the blinding flash of the atomic detonation (the thermal flux or fallout which was the heat generated from the explosion). There were concerns that this heat might burn holes in aircraft exposed to high degrees of thermal flux and different colours were assessed which might effect it better than others. It was felt that 'dark' service markings such as red and blue roundels, fin flashes and serial numbers, together with some ground servicing instructions might absorb too much heat and so for the 'Grapple' aircraft many of these areas were coated in special green paint. The white livery comprised matt white on top of gloss white and the entire paint scheme had to be cleaned at regular intervals and repaired if damaged. Finally, all black rubber seals were changed to white seals or painted white.

A training programme using 100 lb (45kg) bombs was completed by 23rd April; altogether 114 were dropped and these trials were made from an altitude of 45,000ft (13,716m) with the average error calculated to be 450 yards (411m), more than was desired. XD818, XD822, XD823 and XD824 had left the UK for Australia by or on 15th March 1957, XD825, XD827 and XD829 departed on 10th May but XD857 stayed in Britain a little too long to take part. The Pacific-based test programme, including live and practice bomb drops, began as follows:

3rd May 1957	XD822	10,000 lb HE
5th May	XD824	10,000 lb HE
11th May	XD818	10,000 lb HE
15th May	XD818	10,000 lb Live
18th May	XD824	10,000 lb HE
23rd May	XD822	10,000 lb Inert
23rd May	XD822	10,000 lb Inert
25th May	XD822	10,000 lb HE
28th May	XD822	10,000 lb HE
31st May	XD822	10,000 lb Live

(data taken from *RAF Nuclear Deterrent Forces* by Humphrey Wynn, HMSO, 1994).

Two of the first four aircraft, XD818 and XD823, were selected to drop the first weapon which was codenamed Short Granite and comprised a Green Granite Small warhead in a Blue Danube casing. This thermonuclear fusion bomb weighed 10,000 lb (4,536kg) of which the nuclear device totaled 4,200 lb (1,905kg) and was contained in a lead bismuth casing. XD818 departed the UK on 2nd March 1957 staging through Aldergrove, Goose Bay, Canada, Namao and Travis in the USA and Honolulu, before landing on Christmas Island.

At 11.38 local time on 15th May 1957, 49 Squadron Valiant XD818 successfully dropped a test round about a mile (1.7km) from the southern tip of Malden Island (it is believed that this device may not have been a two-stage thermonuclear weapon). The aircraft was captained by Wg Cdr K G Hubbard OBE DFC and crewed by Flg Off R L Beeson (second pilot) and Flt Lts A Washbrook DFC (navigator), E J Hodd (observer) and E Laraway (signaller). The bomb was released at 35,000ft (10,668m) and detonated at the required height. As soon as the bomb had left the aircraft the pilot went into his escape manoeuvre which comprised a turn of 60° bank at Mach 0.76 with 1.8 to 1.9 excess 'g'; it took the pilot 38 seconds to get onto a heading of 073 degrees true.

The evasive manoeuvre had been carefully worked out by Vickers test pilot Brian Trubshaw beforehand. At the moment of release, a maximum rate turn through 180° was introduced so that the Valiant could depart on a reciprocal heading at full power. All of the anti-flash measures needed the aircraft to be tail-on to the blast but if the pilot pulled too hard he risked a high-speed stall. If successful, the Valiant would be nearly ten miles (16km) away at the moment the bomb burst. About two and a half

Top left: **Four Valiants lined up on Christmas Island.** Pete Williams collection

Above: **The crew of XD818 climbing aboard their Valiant, Wg Cdr Hubbard (CO 49 Squadron) and his team plus, on the left, the Chief Technician who was responsible for the aircraft's maintenance.** Pete Williams collection

Left: **XD818, flown by Wg Cdr K G Hubbard OBE DFC, was the Valiant that dropped Britain's first H-bomb on 15th May 1957.**

Below and opposite page, top: **XD823 performed the third 'Grapple' test and was also the first Valiant to be painted with 'anti-flash' white paint.**

Right: WZ391, a B(PR)K Mk.1, was delivered to 543 Squadron on 28th March 1956 and is believed to have served with the unit until 1964.

minutes after release the aircraft felt the air blast from the exploded weapon but turbulence was negligible. After six minutes the special cockpit window shutters were opened and the pilot rotated the aircraft to take a look at the mushroom cloud.

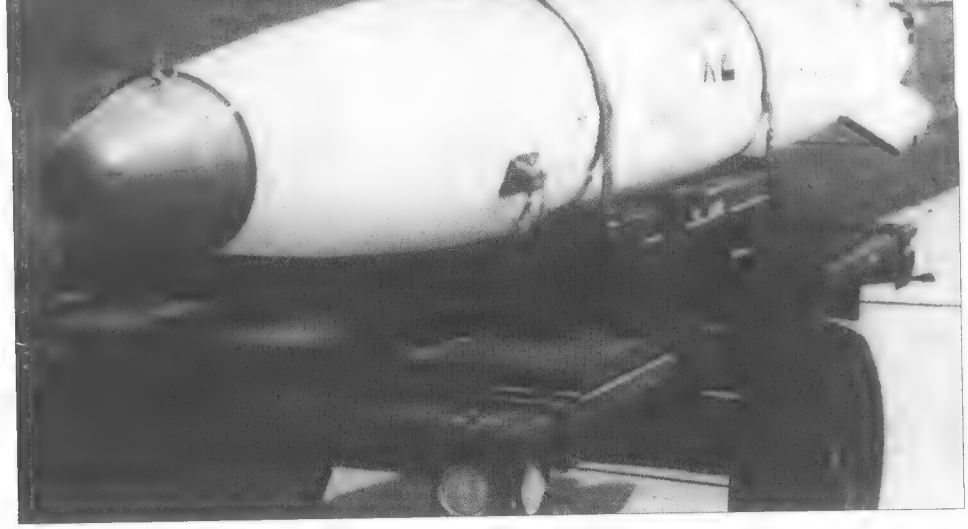
Other aircraft in the vicinity during the test were a 'Grandstand' Valiant, five 76 Squadron B(I) sampler Canberras and a single Canberra PR.7 from 100 Squadron carrying out reconnaissance and meteorological work. The Grandstand Valiant, XD824 piloted by Sqn Ldr C C Millett, acted as a chase plane and its crew was able to watch the atomic mushroom cloud form from an explosion of 0.3 Megatons; in fact the lithium deuteride only partially ignited because the yield should have been about 1Mt. After becoming the first aircrew to drop a British H-bomb, Wg Cdr Hubbard and his crew were all awarded the Air Force Cross.

XD822 dropped the second bomb on 31st May again from about 35,000ft (10,668m) off Christmas Island. This 'Grapple 2' drop was flown by Sqn Ldr Roberts and tested a backup fission device again housed in a Blue Danube casing.

On release the Valiant's accelerometer packed up which meant the pilot did not know his 'g' reading. He thought the meter could not be wrong and so increased the backward pressure on the control column; this made the aircraft stall and it took the crew some 43 seconds to get the Valiant back into normal flight.

On 19th June a third weapon was dropped off Malden Island from about 35,000ft by Sqn Ldr A G Steele and his crew in XD823. The warhead was codenamed Purple Granite and was a modified and possibly larger version of Green Granite with a weight (not including explosive) of about 6,000 lb (2,722kg). The explosion yielded just 0.2Mt which made it the least successful so far.

A further series of tests were made over the Maralinga range in the autumn of 1957 under Operation 'Antler' and began with detonations on 14th and 25th September before culminating in a 25kt test on 9th October. Two were exploded on towers, the third device was suspended from balloons. On 21st August two Valiants from 543 Squadron, WZ391 and WZ392 commanded by Sqn Ldr G D Cremer, were detached to Edinburgh Field to join Air Task Group Antler and both aircraft undertook radar and photographic-reconnaissance of the detonation sites before, during and after each explosion. The detonations were sometimes cancelled because of the weather but, as the Valiants were based 450 miles (724km) away,



they were often in the air before this was announced. As a result the aircraft had to reduce their fuel load sufficiently to get down to a safe landing weight. During their detachment these aircraft also flew three sorties to collect data for the Weapon Research Establishment's Blue Steel project before returning to Wyton on 22nd October.

The teams then moved back to Christmas Island for a series of tests ending with 'Grapple X' when a 49 Squadron Valiant undertook the first completely successful British H-bomb test 'Grapple X', the fourth thermonuclear bomb drop, used in this case a Green Granite Small warhead in a Blue Danube case and was dropped on 8th November from 35,000ft to 40,000ft (10,668m to 12,192m) by XD825 flown by Sqn Ldr B T Millett. The yield was one of the highest achieved so far, 1.8Mt.

On 28th April 1958 49 Squadron's XD825 flown by Sqn Ldr R M Bates, dropped a full-fledged hydrogen bomb in a test called 'Grapple Y'. This was a similar operation to those conducted the previous year but initially only four Valiants were to take part (XD823, XD825, XD829 and XD857), each a veteran of the earlier programme. Later some backup aircraft were sent out to allow the four Valiants to return to the UK for servicing; these included XD818 (departed 25th October 1957), XD873 (1st November), XD824, XD828 (9th August 1958), WZ389 (2nd September), XD817 and WZ401 (5th September).

'Grapple Y' was the fifth thermonuclear weapon test and again used a Blue Danube but this time it contained a Green Granite Large warhead which delivered a massive 3.0Mt yield and remains the largest nuclear device that the British ever exploded. XD824 flown by Sqn Ldr G M Bailey undertook the 'Grandstand' role flying approximately two miles (3.2km) behind and 2,000ft (610m) lower than the bomber while two other Valiants, XD818 (Flt Lt T E Chambers) and XD827 (Sqn Ldr E J G Flew) orbited about 50 miles (80km) from the drop position.

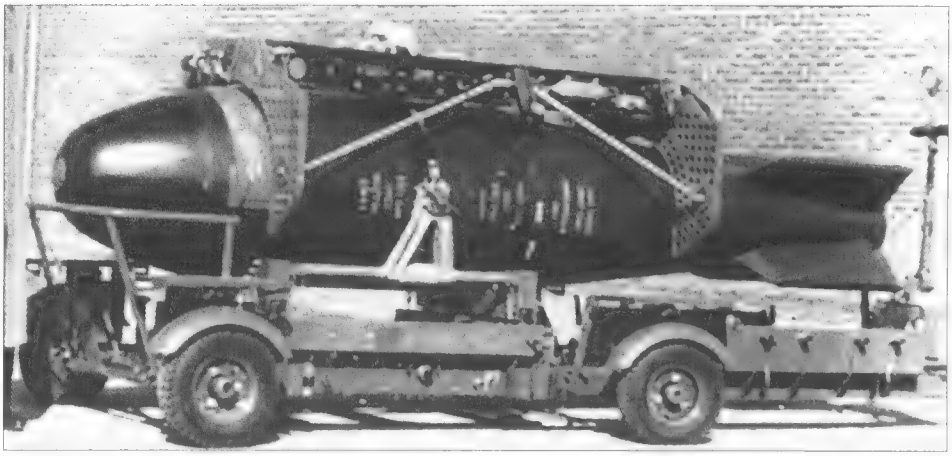
No 49 Squadron found itself in the Pacific again in July 1958 for 'Grapple Z' which in September saw the dropping of two operational weapons. 'Grapple Z' was undertaken on 28th September 1958 by Sqn Ldr G M Bailey and crew in XD822 and the bomb comprised a device termed 'Flagpole' housed in an old Blue Danube casing. This was the first device to be dropped by ground-controlled radar and achieved a bombing error of only 95 yards (87m) from a release height of 46,000ft (14,021m). The 'Grandstand' Valiant was XD818 flown by Flt Lt S O'Connor.

The seventh and last device exploded was called 'Halliarda' and was dropped in a visual attack on 11th September 1958 from XD818 flown by Flt Lt S. O'Connor. The 'Grandstand' aircraft was XD824 (Sqn Ldr H A Gaillard) and the accuracy using this method from 46,000ft was 260 yards (238m). These last drops were so successful that the follow-up 'Grapple

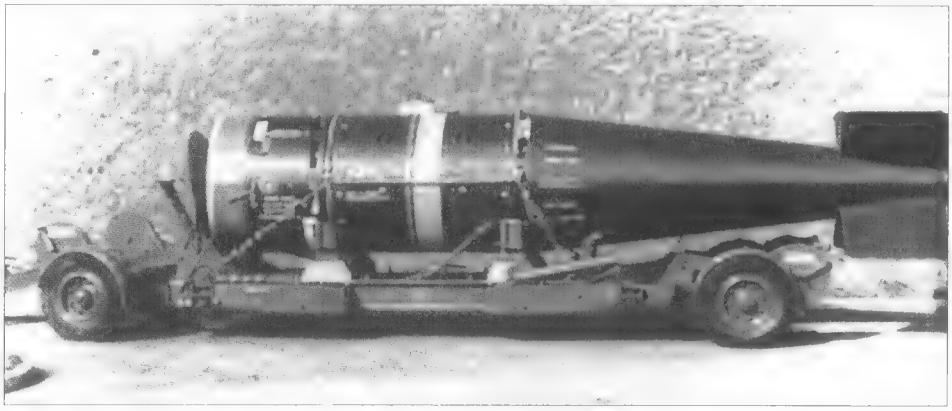
tests were cancelled and the 49 Squadron Valiants returned to Wittering for conversion back to standard configuration with NBS refitted; the unit then joined 3 Group and returned to normal operations. Christmas Island was slowly reduced to 'Maintenance Only' level and Grapple' Force HQ was disbanded on 3rd June 1960.

The RAF's first interim weapon, a 12Mt device, was codenamed Violet Club and the first example was delivered in March 1958. However, it was quickly superseded by Britain's first truly operational megaton-range thermonuclear weapon, Yellow Sun, which weighed 7,000 lb (3,175kg) and was carried by Vulcan and Victor B Mk.1s; the 'Grapple' trials provided the warheads for the Yellow Sun bomb, the Blue Steel stand-off bomb (whose warhead was called Red Snow) and the Red Beard tactical weapon. Violet Club's shape was similar to Blue Danube so its carriage by a V-Bomber presented no problems. Twelve were ordered and their final disposition (by the end of 1958) saw the first four examples based at Wittering, Nos 5 to 8 plus 11 at Finningley and Nos 9, 10 and 12 at Scampton. Initially they were intended for carriage by all three V-Bombers but late in 1958 this was switched to Vulcan and Victor only; the Valiant Force was rescheduled to take just the kiloton-range Blue Danube.

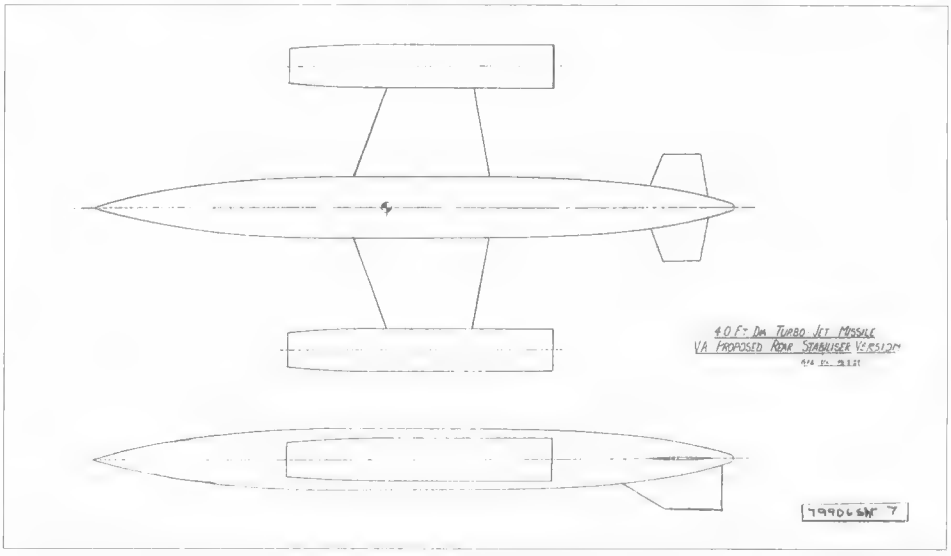
Not all of the air-delivered nuclear weapons carried by RAF bombers during the 1960s were of British origin. A number of US nuclear bombs were made available to Bomber Command and these included the 2,100 lb (953kg) Mk.43 weapon which was carried by both the Valiant and Canberra. They were used by the new Valiant Tactical Bomber Force (described in Chapter 6) which was eventually forced to fly at low-level. On 13th July 1962 a force of Valiants comprising WZ381, WZ392, WZ394 and WZ397 completed a final series of trips to Australia, the part of the world that had seen the Valiant perform its most important work.



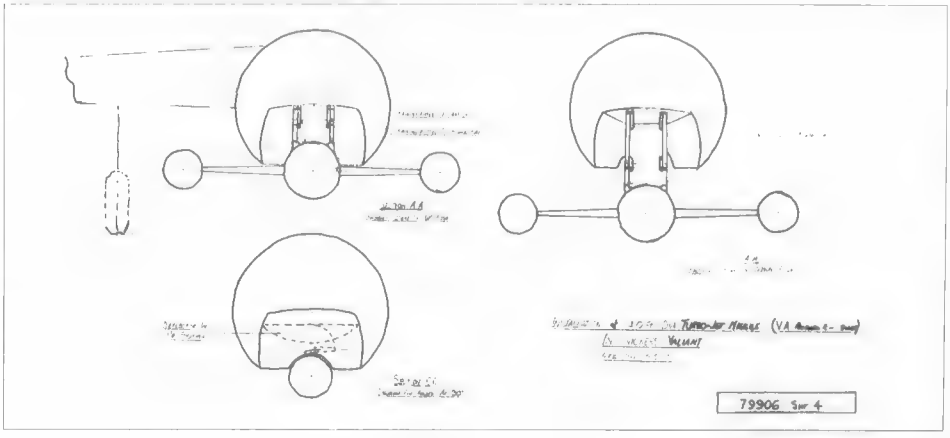
The British Red Beard tactical nuclear weapon was carried by the Valiant Tactical Bomber Force in its low-level role. W Carter collection



Grapple' trials flown by RAF Valiants supplied the warheads eventually used in Yellow Sun. This view shows a Yellow Sun Mk.2. W Carter collection



The 4ft (1.22m) turbojet missile proposed by Vickers with a rear stabiliser (Drawing No 79906 Sheet 7).



Three drawings showing how the Vickers missile would fit into a Valiant, the 'up' position and then the extension ready for firing.

Photographs on the opposite page:

The result of one of the British H-bomb tests in the Pacific as photographed by a Valiant.

A US 2,100 lb (953kg) Mk.43 tactical nuclear bomb. W Carter collection

All of these early atomic and hydrogen bombs were free-fall weapons but the rapid improvement of enemy air defences spurred the development of alternatives that did not require the carrier to pass over the target. An early attempt to give RAF bombers a stand-off capability and better accuracy came in the form of the Vickers Blue Boar TV-guided glide bomb, development of which commenced in 1947. Blue Boar's guidance system, however, had a limited range and so the weapon was cancelled in 1954.

It was replaced by the much more ambitious Avro W.100 Blue Steel air-launched guided weapon designed to be carried under the fuselages of the Vulcan and Victor; the Valiant, however, played a key role in its development programme as a testbed and the modification job for this work was the biggest ever received by the aircraft. Blue Steel was a cruise missile which was designed to be flown within range of a target by its parent aircraft, after which it would then be jettisoned to complete the journey to the target under its own power and internal inertial guidance. On arrival over the nominated target Blue Steel would put itself into a dive and its nuclear bomb would detonate on impact.

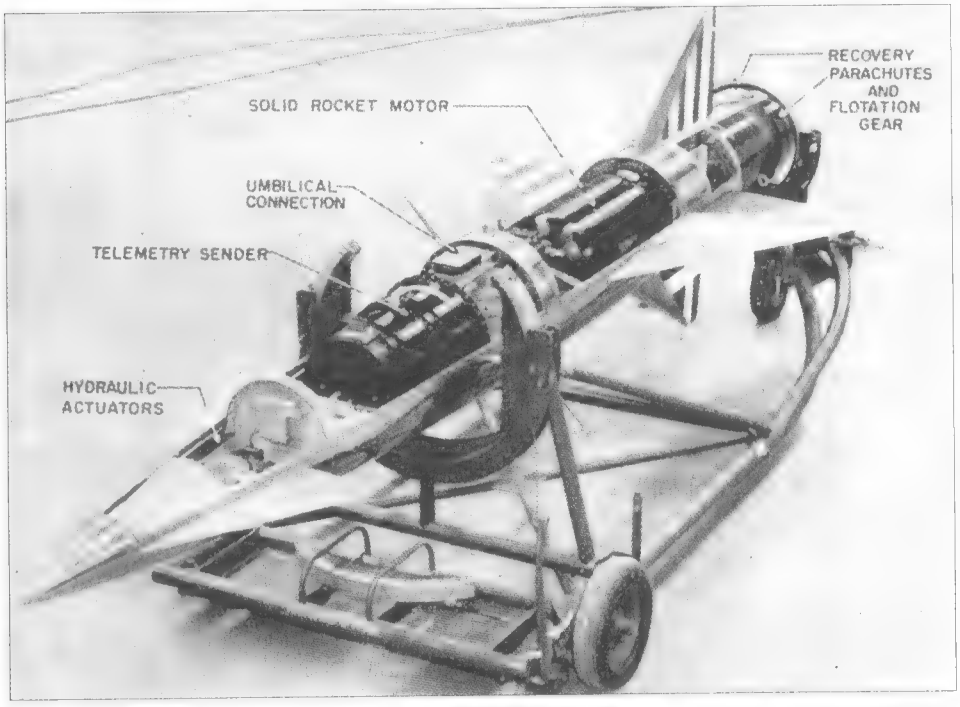
Vickers had also studied some 'cruise missiles' of its own. On 29th April 1955, at a meeting held at RAE, Vickers was asked to investigate the installation and carriage of four types of missile: a 3.0ft (0.91m) diameter rocket missile of 8,500 lb (3,856kg) weight, a 4.0ft (1.22m) diameter rocket missile weighing 14,850 lb (6,736kg), a 4.0ft diameter turbojet missile of 14,550 lb (6,600kg) and a 5.5ft (1.68m) diameter rocket missile of 30,000 lb (13,608kg). It was agreed that Vickers should offer alternative proposals for a shortened version of the 4.0ft rocket missile and a rear stabiliser version of the 4.0ft turbojet weapon. The company considered that wing installations for the 4.0ft missiles were impracticable, mainly due to interference with the undercarriage retraction. The 3.0ft diameter missile seemed more practicable because interference with the undercarriage seemed avoidable but the preferred option was to carry a missile on each wing. The Valiants could be converted back to their Blue Danube role as and when required.

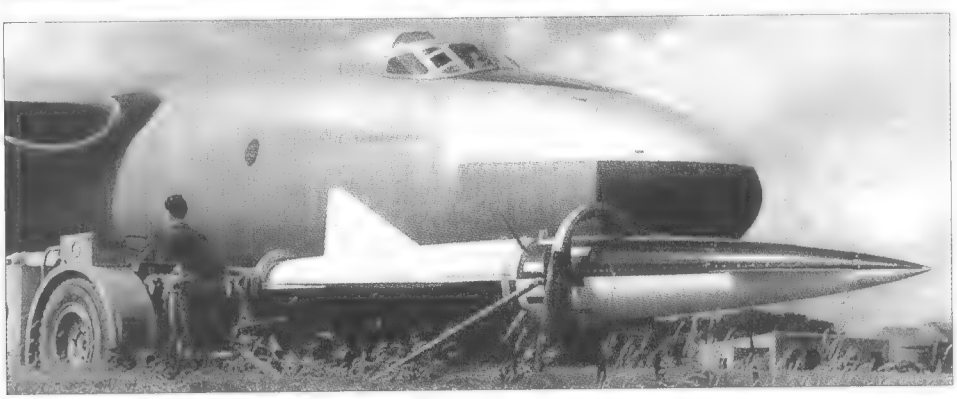
However, all of these weapons would be carried in the bomb bay; only the 4.0ft diameter turbojet with the rear stabiliser is illustrated which was eventually estimated to weigh 13,900 lb (6,305kg). After the missile was fired at its target, the cruising range at 440 knots (815km/h) with engines running was quoted as 2,610nm (4,836km), with engines stopped 2,980nm (5,522km), or 3,440nm (6,374km) if the missile was carrying a 10,000 lb (4,536kg) internal bomb load. None of these flying bombs were ever completed.

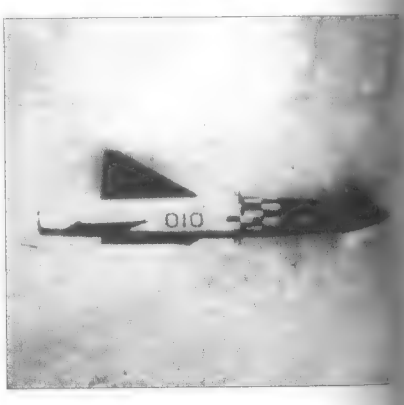
On 19th September 1956 WZ370 was delivered to Avro's Woodford site for Blue Steel modification and testing and from there it flew trials with the 19/15 test vehicle (a 2/5ths scale W.100) installed in the bomb bay. Some store vibration was experienced but an alternative form of suspension cured the problem early in January 1957. Also in January Vickers received contract 6/Aircraft/14455/CB.6 covering the design and trial installation of Blue Steel in a Valiant aircraft. On 30th October 1956 a meeting between Vickers and Avro had specified three types of store – the W.100 operational missile made in stainless steel, the W.102 light alloy unpowered vehicle with fixed controls and the W.103 powered and controlled test vehicle also in light alloy.

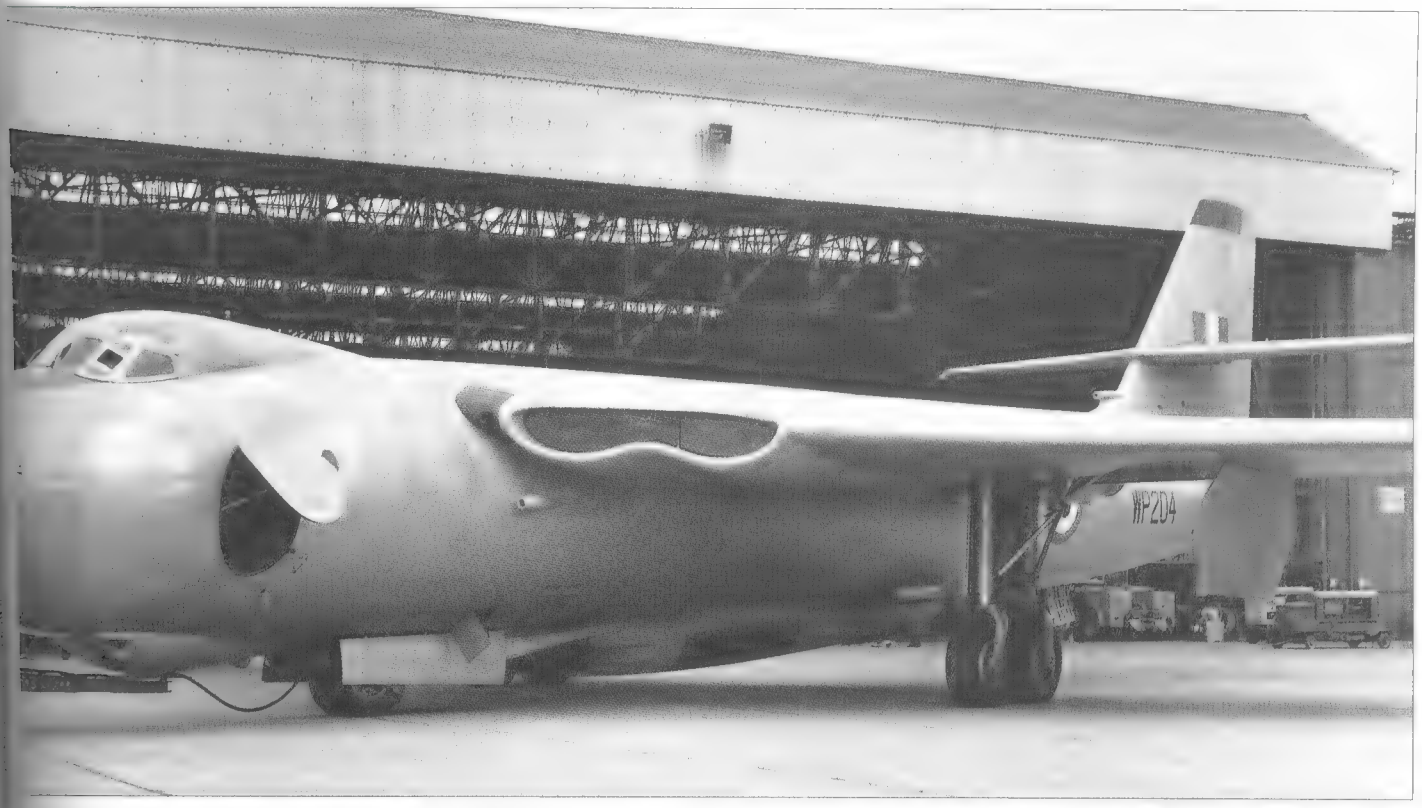
After Vickers had finished working on the aircraft, WP206 was used by Avro to drop trial examples of W.103 and W.100 without a guidance system. Avro confirmed that the surface finish of the aluminium stores, W.102 and W.103, would be in either dayglo (fluorescent) paint, matt-black, anodised aluminium or polished as desired; the W.100 would be polished stainless steel.

During 1957 the first series of Blue Steel trials were made using 2/5ths scale models launched from a Valiant. The store was carried inside the bomb bay and dropped as a ballistic bomb using the normal bombing circuits, the autopilot then taking over with the motor firing a few seconds after launch and accelerating to supersonic speed. Certain programmed test manoeuvres were carried out and some of these flights lasted several minutes before normally being terminated by the operation of the destruct system. The photograph shows such an example just after dropping, the rocket firing seconds after the release. By the end of 1957 these model experiments were complete but a few carried out in early 1959 for training purposes. Valiant WZ370 departed for Australia on 16th August 1957 for these trials (it returned on 17th November 1959), while WZ375 undertook some 2/5ths scale missile trials in the UK.









WP204 fitted with Blue Steel and showing the very small clearance between the bomb and the ground below – what if a tyre burst?

Another view of the Blue Steel test round in position under the Valiant. The paint scheme was designed to help film cameras follow the missile in flight and to determine if the bomb was stable (or not) when flying.

This picture of a dummy ballasted Blue Steel in position underneath a Valiant (probably WP204) at Marshalls Flying School shows just how big this missile was. The aircraft's bomb doors have been removed.

…ographs on the opposite page:

…erior of a 2/5ths scale model Blue Steel.

…ummy Blue Steel being transported to …Vickers Valiant carrier.

…5ths scale model Blue Steel in flight …owing its distinctive markings.

There were to be two sets of full-scale Blue Steel tests comprising:

Phase 1 – unnavigated trials with Valiants (including WP206) and later Avro Vulcan B Mk.1 XA903.

Phase 2 – navigated trials. WZ373 was to be the first aircraft, WZ375 joined later as the second Phase 2 aircraft after finishing its 2/5ths scale tests in December 1958. Authority was obtained on 16th April 1958 for WZ373 to be converted by Vickers for Phase 2 trials under contract 5/KD/P/065; WZ375's conversion for Phase 2 trials was confirmed on 3rd June under 5/KD/P/070.

Blue Steel was bigger than any missile previously built in Britain. It was 35ft (10.67m) long, had a 13ft (3.96m) span and its body was made in stainless steel. Early test rounds were powered by a de Havilland Double Spectre rocket firing through twin blast pipes (production units had an Armstrong Siddeley Stentor) and using kerosene as fuel with hydrogen peroxide (HTP) as an oxidant. Contact was made via a 24-channel telemetry system and a simple autopilot controlled the missile on a pre-programmed path. After release the rocket would accelerate the missile to Mach 2.5 at 70,000ft (21,336m) and then a small sustainer would propel it for the remainder of its flight. Both combustion chambers would fire at launch but after supersonic cruise was achieved the large chamber was terminated by the flight computer. The small chamber would then run at full thrust for the climb until throttled back for cruise by the computer.

A meeting at Weybridge on 3rd January 1958 suggested that WP203 should be used for Blue Steel trials; the minutes read: 'Some time ago WP199 was allocated for Blue Steel trials and WP206 for Inertia Navigation trials. Subsequently, the roles were reversed but it has since been found that WP199 cannot be ready for delivery to A V Roe Ltd in time for their Inertia Navigation trials. WP206 had been allocated for this and all Blue Steel work on it had ceased. It is necessary, therefore, to find another aircraft for Blue Steel and WP203 has now been suggested.' In fact, WP204 was the example eventually chosen to be modified for Phase 1 trials.

Marshalls Flying School at Cambridge was contracted to modify Valiants to take full scale Blue Steels and three, WP204, WZ373 and WZ375, were required to be converted by the end of February, end of June and the end of July 1959 respectively. WP204 was flown to Marshalls on 6th February 1958 and was delivered to Vickers at Wisley on 25th February 1959 after completing initial drops and pre-strain tests. There were three support points from which the missile was slung: front, centre (the hoist point) and rear.

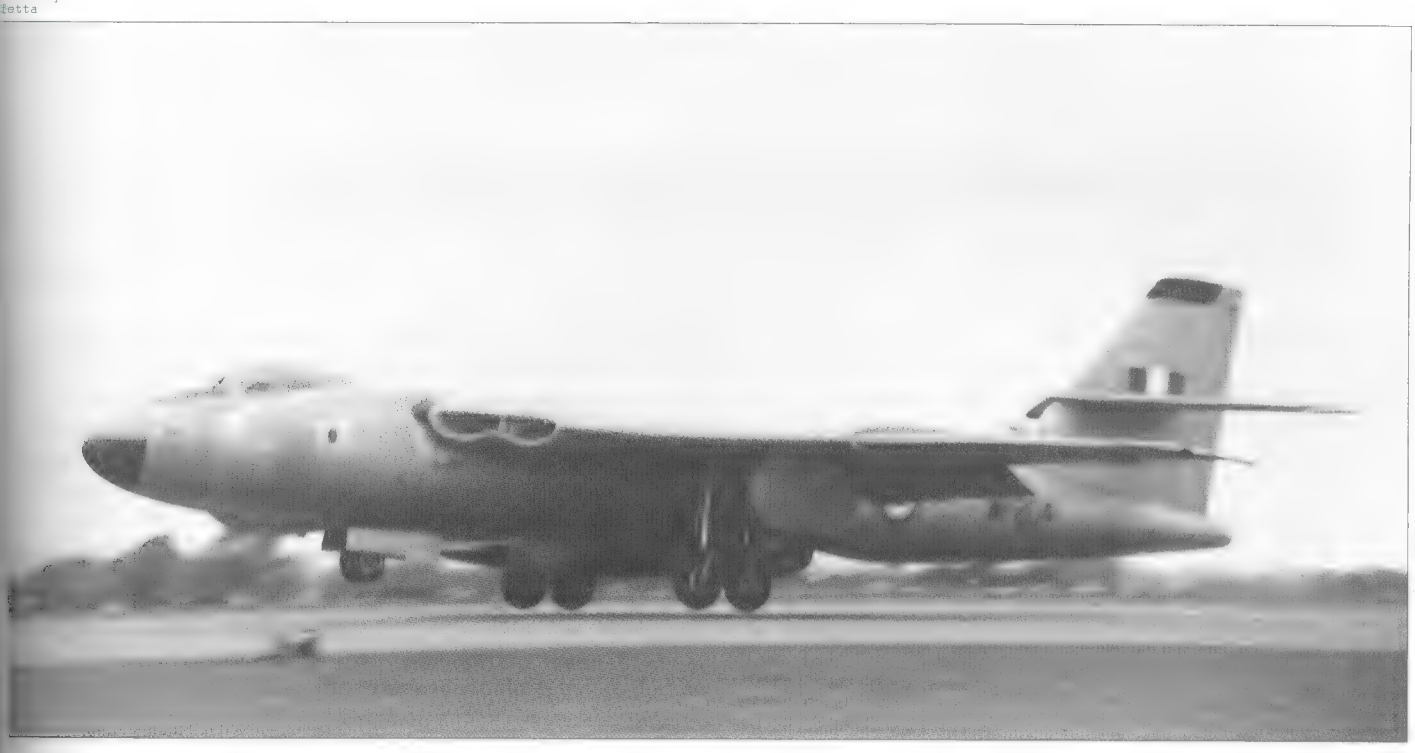
In the early weeks of February WP204 had made 12 static drops of a W.102 store on the ground to ensure that the release circuits and mechanisms were operating in a satisfactory manner and to check the disengagement of the store connections on the store's release from the aircraft. After release the missile was caught in a cradle placed beneath the aircraft, the free fall distance being about 3in (7.6cm). The last release was made on 19th February and then WP204 went to Wisley to begin full-scale flying trials.

After refuelling at Wisley the aircraft was found to be sitting too low to load the W.102 round and so its nose had to be jacked up to allow the bomb to be positioned correctly. The latter's jettisonable tail cone was not fitted and its lower fin was kept in the folded position, remaining thus during the first flight the following day. The first take-off was made at 11.29 hours on 14th March 1959 for a flight that lasted 31 minutes. A second was made on 17th March which lasted 30 minutes and in view of the buffet experienced during the first sortie the jettisonable tail cone was now fitted and during the flight the store's lower fin was lowered to the extended position.

The third flight, a 45-minute trip, took place on 20th March and here the jettisonable tail cone was omitted again to determine if the buffet would fade out at higher altitudes and speeds, but the flight confirmed that the fairings were a necessity. At this time Vickers produced some maximum range data for the Valiant when carrying Blue Steel – without wing tanks and flying at 440 knots (815km/h) and 45,000ft (13,716m) with the missile released at its target its range was 2,400nm (4,447km), with wing tanks the figure at 435 knots (805km/h) and 45,000ft was 3,185nm (5,902km).

The first Blue Steel drop should have occurred on 24th March with the release at 40,000ft (12,192m) and Mach 0.8 of W.102 round 003. The missile weighed 15,000lb (6,804kg) and had no motor or guidance and all of its surfaces were locked at zero incidence. It had a black nose and control surfaces and the rear two-thirds of the body were a mix of black and yellow quarters. Assuming 100ft/sec (30.5m/sec) wind and 1/2° incidence, the missile's range was estimated to be 17,000 yards (15,545m); however, troubles with the Blue Steel round and WP204 postponed the test until 13th May. One problem was the accidental jettisoning of the trial store onto the ground on 25th March which damaged the weapon and forced Vickers to ask for a replacement. Eventually four test drops were made and oscilloscope cameras were used to record the events but on three occasions the film jammed and no record was possible. The missile had to withstand a maximum acceleration of 11.8 during release.

WP204 finished its preliminary flight trials in April 1959 which confirmed that jettisonable rear fairings would be required on the aircraft to eliminate buffet up to 330 knots (611km/h).



Above: **WP204 takes off for a trial flight with its Blue Steel test round.**

Opposite page, bottom: **WP233 drops a dummy Blue Danube in May 1959 over the Jurby range while serving with 90 Squadron. The pilot was Sqn Ldr Norfolk.** Peter Green collection

16th April two prototype fairings were in hand, the first to be fitted to WP204 for Vickers trials and the second after delivery to Avro at Woodford. Plans were made to manufacture 70 fairings – eight examples of the prototype design including the two already mentioned and 62 to the production design – but flight trials showed the fairings were unacceptable and the buffeting was still there. Vickers then fitted sealing plates around the store to close the gap between store and fairings and added fences between one fairing and the store's main plane. This was completed by 20th April and when flight tested at high altitude and high-speed buffet was almost nil.

The problem had been overcome and the tail fairing was not required (the production examples were cancelled) but an additional nose fairing skirt and seal all around the store was needed. With this new skirt, store release was now possible at 40,000ft (12,192m) and Mach 0.8 while flight with a 'clean' aircraft was OK. A missile drop was now required to check the fairing and bomb release method and on 19th May WP204 successfully released a dummy missile over the Aberporth range. WP204 left for Australia on 15th August 1960 and returned to the UK on 4th January 1962.

In the meantime conversion work was expected to begin on the second and third Blue Steel Valiants'. As already noted, WZ373 was estimated to be ready in June 1959 but the aircraft did not return to Wisley from Boscombe Down until 18th April; it then flew to Marshalls on 14th July and on to Woodford on 20th August. The delays on this aircraft put the whole programme back several months and it finally flew to Australia on 27th October 1960. WZ375 had first arrived at MFS on 14th January 1957 for alterations to allow it to carry the 2/5ths scale Blue Steel models and went to Avro on 5th July for those trials. It returned to Marshalls Flying School again on 25th February 1959 for the full size missile conversion; delivery to Australia was planned for December but this aircraft was also late, finally leaving the UK on 24th March 1961.

One fuel consumption assessment of the Blue Steel Valiant flying from Edinburgh Field in Australia, beginning at an all-up-weight of 136,500 lb (61,916kg), estimated that taxying would take five minutes, climb to 40,000ft (12,192m) en route to the Woomera range 35 minutes, cruise at 7,600rpm at 220 knots (408km/h) EAS (Mach 0.77) at 40,000ft 86 minutes, descent 12 minutes and circuit and landing at 107,500 lb (48,762kg) weight six minutes. The total time for the sortie was thus 144 minutes and this would leave 704gals (3,201 lit) of fuel in the fuselage and 952gals (4,329 lit) in the wings. The weights of the Blue Steel Valiants were now steady at 21,309 lb (9,666kg) for the complete installation with the test weapon weighing 15,009 lb (6,808kg) and increasing to 17,000 lb (7,711kg) for the fully equipped version. Dropping speed was to be 290 knots (537km/h) EAS, or Mach 0.8, at 40,000ft.

In Australia the three Valiants would begin by carrying out extended carriage trials, many of four hours duration, which would include crew training flights, flights to ascertain the effect via inertia navigator accuracy of an extended carriage of 100nm (185km) after the last fix point (up to 200nm [371km] from the target) and flights to check the effect on inertia navigator accuracy of an evasive manoeuvre made prior to the last fix point (two evasive manoeuvres separated by a time interval of about 45 minutes would be made on these flights). During some of the trips the missile would have fuel and HTP aboard and, on completion of this programme, the missile was to be fired at the end of the year (1961) as a pre-acceptance round.

Trials with production Blue Steels with Stentor motors began in summer 1960 using Vulcan XA903 and the RAF's first Vulcan Blue Steel unit, 617 Squadron, achieved an emergency operational capability in September 1962; it became fully operational with the missile the following February. As a postscript, Marshalls' heavy involvement in preparing Valiants for nuclear duties ensured the firm maintained a close association with Vickers thereafter. Eventually Marshalls became the Delegated Design Authority for all electrical and electronic work on the Valiant until it was withdrawn from service.

Historically the Valiant is usually looked on as the 'third string' in the list of V-Bombers; the Victor and particularly the Vulcan tend to get more space in publications about the aircraft. It is true that both served far longer than the Valiant but it is sometimes forgotten that, until the end of the 1950s, the Vickers V-Bomber formed the mainstay of the RAF's strategic deterrent. When it entered service it introduced a vast improvement in performance over previous RAF strategic bombers and it also played a major role testing Britain's nuclear weapons, essentially bringing the country's nuclear deterrence strategy to fruition. As we have seen in earlier chapters, the Valiant also pioneered flight refuelling and tested all of the complex electronic bombing and navigation equipment associated with the V-Bombers. The Vickers Valiant was indeed a very successful aeroplane.

RAF Valiant Unit Histories

No 2 AIR TRIALS UNIT

Formed about June 1958 to accommodate the Valiant; WP206 is the only known example to join 2 ATU which tested the inertial navigation system for the Blue Steel stand-off guided weapon. The last entry is dated 4th March 1960; WP206 was later despatched to Australia.

BOMBER COMMAND DEVELOPMENT UNIT (BCDU)

The intensive flying trials of the Valiant B Mk.1 commenced at Gaydon on 8th February 1955 and were concluded (except for continuing supplementary trials) at Wittering on 21st March 1956. A total of 1,367.3 hours were flown which approximated to that of a peacetime squadron. Some of the defects found to require urgent attention were the cracking of windows, collapse of fuel tanks, various brake system defects and seized fuel filter heater cocks. The range of the VHF radio (STR.18B2) installation was at first disappointing but trials of a redesigned aerial system showed a very worthwhile improvement. Some difficulty was experienced in servicing the Gee-H navigation aid installation.

Phase 'A' trials began at RAF Gaydon with the arrival of WP206, the number of aircraft on strength increasing to eight. On 6th July 1955 four of them flew to Wittering to start Phase 'B' and this strength was maintained throughout except for a three-week period from 29th July after WP222 had crashed. The replacement aircraft, WZ363, arrived on 19th August.

Aircraft used by BCDU were (with dates of arrival and departure):

Serial	Arrival	Departure
WP206	8/2/55	6/7/55
WP207	19/2/55	6/7/55
WP211	16/4/55	6/7/55
WP212	16/4/55	6/7/55
WP213	2/4/55	21/3/56
WP215	30/4/55	21/3/56
WP216	6/6/55	15/7/55
WP220	22/6/55	21/3/56
WP222	15/7/55	29/7/55 (Crashed)
WZ363	19/8/55	21/3/56

During all of these flights the main criticism was severe vibration of the tail unit on overshoot, particularly in excess of 7,000rpm, with resulting interference to the VHF radio which was often acute. The effect of this vibration was more apparent towards the end of the trial and became serious. The pilots reported that the situation may have been aggravated by the use of full power at take-off with brakes on, overshooting with high power from low speed and possibly low-level flying in general.

Besides lots of comments and constructive criticism on the Valiant, the crews also criticised their dispersal accommodation because the buildings had only enough space for about half of the required personnel. In addition the 'H' type aircraft dispersals were described as unsuitable for medium bomber operations because the access tracks were too narrow to be safe, there were too many corners to negotiate taxying in and out and it was not possible to taxi straight in, round and out again. Unless an extra access track was available the aircraft had to be towed backwards onto the standings. In general the design of the 'H' type dispersal delayed the turnaround and brought additional hazards because of the complications of towing. During this period the BCDU ground servicing staff worked very long hours in all weathers.

232 OPERATIONAL CONVERSION UNIT (Gaydon) B Mk.1, B(PR) Mk.1

Formed at Gaydon on 21st February 1955 as part of 3 Group to provide operational training for Valiant crews. The first Valiant received was WZ362 on 22nd July, followed by WZ361 on 12th August, WZ364 on 26th August, WZ368 and WZ369 on 25th October, WZ371 on 4th November, WZ372 on 29th November, and finally WZ374 brought the unit up to strength on 16th December. Other Valiants used by 232 OCU were WP207, WP211, WP212, WP217, WP220, WZ377, WZ379 and WZ381. Later 232 became a Handley Page Victor Operational Conversion Unit.

1321 FLIGHT (Wittering)

This Flight reformed within 3 Group at RAF Wittering on 3rd August 1954 and the first Valiant received was WP201, the third production Valiant. This aircraft was delivered to RAE Farnborough on 21st December 1954 for Ministry of Supply testing before being delivered to Wittering on 15th June 1955. On 6th July it passed to 1321 Flight (after flying 154.35 hours) where it came under very strict security because it was to be used for inert Blue Danube dropping trials on behalf of the Atomic Weapons Research Establishment (AWRE) and RAE. By 19th June 1956, when WP201 flew to Farnborough, it had completed 268.35 hours flying. The Blue Danube trials were continued by 138 Squadron, a neighbouring unit at Wittering, and 1321 Flight was disbanded on 15th March 1956.

7 SQUADRON (Honington) B Mk.1, B(PR) Mk.1, B(PR)K Mk.1, BK Mk.1

This squadron reformed at RAF Honington on 8th October 1956 and from November came under the command of Wg Cdr A H Boxer DSO DFC; from 17th October 1957 it was commanded by Wg Cdr C D North-Lewis DSO DFC. By 1st January 1958 eight Valiants were on strength seven of which were WP207, WZ366, WZ378, WZ381, XD826, XD830 and XD864; in April the number dropped to seven because one example went to Marshalls for major servicing.

The unit flew on many different exercises including 'Bomex' and performed trials with astro navigation and NBS, etc; between 31st and 5th June 1958, WP207, WZ378, WZ381, XD826 and XD864 took part in a larger exercise called 'Full Play'. By January 1960 command of 7 Squadron was in the hands of Wg Cdr G B Mugford. The unit disbanded on 1st October 1962 but one Flight was kept in being until 14th October to represent Bomber Command at the events celebrating Uganda's independence.

18 SQUADRON (Finningley) B Mk.1, B(PR) Mk.1

This unit was reformed on 16th December 1957 from 199 Squadron 'C' Flight, complete with aircraft and staff. It was disbanded in April 1958. (See 199 Squadron entry for serials).

49 SQUADRON (Wittering and Marham) B Mk.1, B(PR) Mk.1, B(PR)K Mk.1, BK Mk.1

Reformed on 1st May 1956 at Wittering with Valiant B Mk.1s WP201 and WZ366 under Sqn Ldr D Roberts DFC AFC. The same day the squadron was visited by Air Commodore C Weir DFC from the Air Ministry and Wg Cdr J Moir to discuss Operation 'Buffalo', the dropping of the first of Britain's atomic bombs (Blue Danube). On 15th May Flt Lt R N Bates collected WZ367 from Waddington and on 31st May 1st June and 7th June Sqn Ldr E J G Fla-

dropped dummy stores F.4/F, F.4/G and F.4/H respectively. Other pilots also dropped dummy stores as part of their preparations to test Blue Danube. On 14th June Air Commodore Weir was appointed Commanding Officer of the Atomic Task Force.

The unit was assigned to SACEUR in 1961 and moved to Marham on 26th June. It became operational in the tactical role in August 1962 and was disbanded on 1st May 1965.

90 SQUADRON (Honington)
B(PR) Mk.1, B(PR)K Mk.1, BK Mk.1

Reformed on 1st January 1957 as a unit of the V-Bomber Force under Wg Cdr F S Hazlewood AFC and received its first aircraft in March. Its intial equipment comprised XD862 straight from the Vickers production line on 1st March, XD863 13th March, XD865 22nd March, XD867 18th April, WZ393 23rd May, WP223 27th May (this aircraft was painted white), XD871 27th June and WZ377 13th November.

On the 14th to the 16th March 1958 two Valiant BK Mk.1s, XD862 and XD865, were flown to Changi, Singapore, to Manila in the Phillipines and then on to Saigon and back to Changi. While in Manila one took the Phillipine Air Force Commander-in-Chief on a local demonstration flight while both aircraft also made a flypast. From Singapore, XD862 flew to Darwin and then to Edinburgh Field in Australia on 25th March; on 27th it continued to Ohakea in New Zealand and gave a display on the 29th. On 1st and 11th April 1958 two Valiants, XD871 and XD867, flew to Marshalls of Cambridge to receive RATOG and water methanol installations. In April 1962 90 Squadron became operational as a Flight Refuelling unit but after the type's grounding in 1965 it was disbanded on 16th April.

Valiant BK Mk.1 XD867 spent its entire service career with 90 Squadron, based at Honington. It is seen here at the RNAS Yeovilton Open Day, 17th June 1961, amidst little security. C J Salter

138 SQUADRON (Gaydon)
B Mk.1, B(PR) Mk.1, B(PR)K Mk.1, BK Mk.1

The first RAF squadron to receive Vickers Valiants, 138 reformed in January 1955 at Gaydon under Wg Cdr R G W Oakley DSO DFC AFC DFM. On 6th July it moved to Wittering with WP213, WP215 and WP220. By 2nd January 1956 the Valiants on strength were WP206, WP211, WP212, WP213, WP215, WP220, WZ363 and WZ384 and the squadron took its aircraft to Malta during the Suez landings.

Earlier, two aircraft, WP206 and WP207, went on Overseas Proving Trials under Operation 'Too Right' and on 5th May 1956 an Exercise called 'Rejuvenate' used four aircraft, WP213, WZ363, WZ384 and WZ389, to test the defences of the north-western UK areas. Three of these aircraft carried out a daylight raid (one having returned early with pressurisation trouble) and two a night sortie; all of the 'raids' were classed as successful. HRH Queen Elizabeth II visited Marham on 9th July and was saluted by a formation of three aircraft, WZ401, WP215 and WZ389. On 13th August 1956 Wg Cdr Oakley became the first pilot to land a Valiant in Malta (flying time for the return journey was 6hrs 28mins). No 138 Squadron was disbanded on 1st April 1962.

148 SQUADRON (Marham) BK Mk.1

Reformed on 1st July 1956 at Marham under Wg Cdr W J Burnett DSO DFC AFC. Its first aircraft, BK Mk.1 XD814, was collected brand new from the Vickers works, being flown out of its nearby airfield at Wisley on 26th July 1956. The squadron was based at Malta for the Suez crisis and on 31st October XD815, XD819 and XD814 attacked Almaza airfield with XD816 and XD817 also hitting the same target later. On 1st November Fayid airfield was raided by XD814, XD815, XD816 and XD819, each dropping 12 1,000 lb (454kg) bombs. The final raids were made on 4th November when XD814, XD815, XD816, XD819 and XD817 each dropped 12 1,000 lb bombs on Huckstep Barracks.

An exercise called 'Green Epoch' was held between 13th and 15th February 1957 with the intention of giving US Sixth Fleet fighter defences the chance to 'shoot down' attacking bombers. In the first two days 148 Squadron carried out eight night attacks and on the third day four daylight attacks, all of which were declared successful; only one interception was made by two Grumman F9F-9 Cougars using afterburners at 40,000ft (12,192m) – other Cougars were seen unsuccessfully trying to gain height. An initial diversion attack had been carried out to draw the fighters into the air before, when the Americans were airborne, the Valiants turned around and flew out of range. Then, 35 minutes later, the bombers returned to attack the fleet very successfully and none of the Valiants were claimed as shot down.

Another mission for 148 Squadron was the sending of two aircraft, XD819 and XD820, to the Gold Coast on 28th February 1957 for that country's independence celebrations (when it was renamed Ghana). A formation flypast on 4th March effectively sealed this occasion. During that same year three 148 Squadron aircraft, XD814, XD815 and XD819, participated in the Queen's Birthday flypast on 13th June. The squadron was eventually assigned to NATO and had became operational by April 1963. After the Valiant force was grounded, 148 Squadron was disbanded on 28th April 1965.

199 SQUADRON (Honington) B Mk.1

This unit had reformed for radio counter measures work at Watton on 16th July 1951 using Avro Lincolns and de Havilland Mosquitos and on 17th April 1952 it moved to Hemswell where it began to acquire English Electric Canberra B.2s modified to carry ECM equipment. Another move took the unit to Honington after which it received some Valiants: WP213 on 29th May 1957, WZ372 on 21st June, WP215 on 16th September, WZ365 on 1st November, WP216 on 14th February 1958, WP212 on 22nd April and WP211 on 16th December. Its aircraft were fitted with American RCM/ECM systems includ-

ing ALT-7 and APT-16A jammer transmitters, APR-9 and APR-4 search receivers and some foil dispensers. This type of equipment was designed to jam night fighter AI radars and one of several trials (Trial 362) was flown by WZ372 in February 1958. On 3rd March WP215, which had been used for aircrew training, went to Watton to have RCM equipment fitted and returned to the unit on 9th July.

There were two accidents in September 1958. WZ365 had an engine failure on 4th just before take-off which led to a fire in the starboard wing and on the 10th WP215 lost number two engine while flying in the station circuit which caused a fire in the port wing; both were heavily damaged (WP215 Cat 3 repair). The 199 Squadron Valiant flight, or 'C' Flight, was disbanded on 15th December 1958 but was reformed as the basis of 18 Squadron on 17th December under Wg Cdr D J A Roe DSO DFC, flying from Finningley in 1 Group.

207 SQUADRON (Marham)
B Mk.1, B(PR)K Mk.1, BK Mk.1

Reformed on 1st April 1956 at Marham under Wg Cdr D D Haig DSO DFC. Postings commenced on 28th May and by 11th June the unit knew that Her Majesty the Queen would be presenting the Standard to the squadron. Dummy swords were obtained from Wyton so that the CO and his officers could practise parade ground duty; by this time 100 out of the 144 ground crew scheduled for 207 Squadron had arrived. The first Valiant B Mk.1, WP223, was received and first flown by 207 on 11th June and it was followed by WP221 on 18th June, WP219 on the 26th and then WZ403, WZ404, WZ405, WZ406, XD812 and XD813.

On 23rd July 1956 Her Majesty and HRH the Duke of Edinburgh visited Marham to review Bomber Command and its aircraft and the Queen presented the Standard, which had been approved by King George VI, to the squadron. The Bomber Command flypast consisted of eight wings of nine Canberras in vics of three, followed by 20 Valiants from 138, 207, 214 and 543 Squadrons and 232 OCU in five boxes of four, the biggest number of Valiants that had been in the air at any one time so far (although only two belonged to 207). Eight days later Flt Lt E A F Crookes AFC, flying in WP219 at 40,000ft (12,192m), suddenly found his cabin pressurisation was dropping to sea level pressure. He descended to 23,000ft (7,010m) but then had to depressurise number one engine at 7,200rpm because of a loss in oil pressure and an increase in JPT (Jet Pipe Temperature). He returned to base on three engines.

At Suez 207's first raid was made on 31st October when five Valiants under Wg Cdr Haig attacked Kabrit at night; two aircraft attacked Kasfareet airfield on 1st November and four hit El Agami on the 4/5th, making 207 responsible for 11 out of the 49 sorties undertaken by the Valiant Force at Suez. In April 1957 207 Squadron participated in Exercise 'Red Pivot', another operation designed to test the defences of the United States Sixth Fleet, and again the Americans came off worst. Quite simply, the American fighters just could not reach the Valiant's operating height and speed.

On occasion aircraft were loaned to other squadrons to fulfil their duties if they were short of aircraft and on 2nd October 1957 XD875 was loaned to RAF Wittering, returning to 207 on 13th November. On 4th November 1957 XD813 had been picketed outside, as normal, when a gale blew up during the night and a hut was blown into the aircraft by a 71 knot (132km/h) gust of wind. This badly damaged the wing tip and aileron and also made cuts on the port fuselage side, but by 11th February 1958 XD813 had been repaired and flew to Marshalls of Cambridge.

In 1960 207 Squadron won the Laurence Minot and Armament Officer's Trophies in the Annual Bomber Command Competition. Wg Cdr W D Robertson came second in the individual bombing and Flt Lt K M Marwood, in XD813, was second in bombing and also second in navigation. The next year 207 followed this up by winning the Medium Bomber Squadron Efficiency Trophy. A year later part of the Valiant Force, including 207, began to operate at low level. 207 Squadron flew daytime sorties as low as 100ft (30.5m) above the ground, but kept to a minimum 1,000ft (305m) at night. At this time there was no automatic terrain clearance, low-level flying used the 'Mk.1 eye-ball', which must have been somewhat hairy. The squadron received its first American Mk.43 nuclear weapons in April 1962 when it became operational after assignment to NATO. The unit was disbanded on 5th May 1965.

214 SQUADRON (Marham)
B Mk.1, B(PR)K Mk.1, BK Mk.1

This unit reformed as a V-Force squadron on 21st January 1956 at Marham under Wg Cdr Trent VC DFC. The first aircraft arrived on the following dates: WZ379 15th March 1956, WP211 22nd March, WZ377 26th March, WZ393 2nd April, WP212 6th April, WZ395 18th April, WP223 8th May and WZ397 2nd June. In October a flight of 214 Squadron aircraft was based at Luqa in Malta for action against Egypt. On the 28th 214 Squadron carried out four raids: WZ393 to El Adem airfield with six 1,000 lb (454kg) bombs, WZ377 to Almaza with 12 1,000 lb bombs and WZ393 and WZ395 in the afternoon to Abu Sueir each with 12 1,000 lb bombs. On 1st November the target was Kasfrit where WZ397 and WZ393 each dropped 12 1,000 lb while WZ377 deposited another dozen on Huckstep Barracks and WZ393 and WZ395 a dozen each on El Agami.

On 23rd May 1957 214 Squadron received one of the latest BK Mk.1 Valiants, followed by another (XD869) on the 28th. The unit was tasked with investigating the operational side of the new in-flight refuelling system and by 1958 it had completed its operational trials. In April 1962 it was officially declared a Flight Refuelling Tanker Squadron but was disbanded on 28th February 1965 following the order to permanently ground the Valiant.

543 SQUADRON (Gaydon and Wyton)
B Mk.1, B(PR)K Mk.1

This unit reformed at Gaydon on 29th September 1955 under Wg Cdr R E Havercroft AFC to carry out reconnaissance duties using PR Valiants; it moved to Wyton in the following November. Initial equipment, with arrival dates, was as follows: WP217 11th May 1955, WP221 21st June, WP223 28th November, WZ377 29th December, WZ380 13th February 1956, WZ382 15th February, WZ384 2nd March and WZ391 28th March.

By June 1958 aircraft on strength were WZ380, WZ382, WZ391, WZ392, WZ394 WZ396, WZ397 and WZ399 and on the 24th of that month HRH The Prince Philip visited Wyton and witnessed a scramble of four Valiants (five serials are listed as flying in the Operations Record Book – WZ382, WZ391, WZ392, WZ394 and WZ397 – so it is presumed that the fifth machine would have orbited the airfield). On the night of 4/5th July 1958, Exercise 'Freshwind' was used to locate a NATO Fleet moving northwards from Finisterre and to report its position back to Bomber Command. The exercise also embraced a Central Reconnaissance Establishment requirement to take radar pictures (both radial and sidescan) of the fleet from various ranges. Four flights were planned, two by day and two by night, but only the day trips were made, by Wg Cdr R Berry on the 4th and Flt Lt T J Bradbury on the 5th, both of which were a success.

In July 1958 a 'Lone Ranger' trip was flown by WZ382 to show the flag (and the Valiant of course) to the Americans. Places visited were Offutt to Amarillo to Denver and back to Offutt on 16th July, Offutt to Travis to Denver and Salt Lake City on the 18th and, lastly, to Boise and Sacramento and back to base on the 23rd. From November 1958 the emphasis was on scrambles – trying to take off in an operational emergency in the least possible time – because the arrival time for an ICBM (Inter-Continental Ballistic Missile) was expected to be about six minutes from launch. 543 Squadron did excellently getting their time down to six minutes and five seconds but eventually the objective was reduced to four minutes (which was achieved).

A slight mishap occurred on 19th December 1958 when WZ399, taking off from Marham with Sqn Ldr K H F Letford DSO DFC as pilot, was struck by a large flock of birds. The starboard flap was damaged to Cat.2 and evidence of other strikes, in the form of blood and feathers, was seen on the undercarriage and wings. The aircraft landed safely. Due to the grounding following the spar failures, the squadron lost its Valiants in February 1965. However, this time the squadron did not disband but received replacement aircraft in the form of Handley Page Victor B(SR) Mk.2s.

Individual Valiant Histories

Note: The dates listed below were taken from Vickers Aircraft History Cards and the Air Ministry's, MoD's and RAAF Aircraft Movement Cards (from the Australian Department of Defence in Canberra). As one might expect there is more as regards manufacturer's modifications and servicing on the Vickers cards, and more on the contracts and allotments of aircraft on the Air Ministry cards. The Vickers cards give the date that the aircraft arrived and left the Vickers sites whereas the Air Ministry renderings of contracts and allocations do not always coincide with the flight dates, therefore, neither are 100% but they are a good guide to which squadrons held specific aircraft and when.

Two B.9/48 Medium Bomber prototypes ordered 2nd February 1949 to Contract No 6/Air/2339/CB.6(c). Serials allotted 10th December 1948.

WB210 Type 660. f/f 18/5/1951, To Hurn 1/6/1951, [illegible]/1951 Loaned to V-A for SBAC Show, 17/9/1951 to A&AEE Boscombe Down, 29/9/1951 V-A, 12/1/1952 Crashed near Hurn, abandoned by crew following fire in engine bay. This aircraft was not accepted off the contract.

WB215 Type 667. f/f 11/4/1952, Hurn mods 11/6/1952, [illegible]/1952 RAE Farnborough, 18/8/52 loan to V-A for SBAC Show. A&AEE 2/10/1952, Hurn 9/10/1952, 16/10/1952 RAE Farnborough, wing hit ground and damaged, Wisley [illegible]/11/1952. October 1953 modified to Type 709 for London to Christchurch (NZ) Air Race, u/w tanks fitted. 17/12/53 to [illegible] Aircharge, 18/12/1953 accepted off contract – development flight testing under Contract 6/Acft/10113/CB.6, 18/6/54 allotted to A&AEE, 8/7/1954 Wisley to A&AEE, 12/7/1954 Boscombe to Wisley for repair of mainplane, 17/8/1954 Wisley to A&AEE, 20/12/1954 Wisley for Major Inspection, 17/11/55 Allocated for flight tests of Super Sprite, handling trials at aft CofG at high Mach numbers, jet noise investigation, 16/1/1956 DH Hatfield fitting of Super Sprite RATOG rockets, 21/4/56 authority for loan to A&AEE (Super Sprite tests), 1/9/1956 Farnborough SBAC Show fitted Super Sprites, 29/4/1957 Accident at A&AEE (Cat.3 or Cat.4), 15/10/1957 authorised for wing fatigue tests under Contract 6/Acft/15577, 14/12/1957 To Hurn Marston to be broken for wing fatigue tests, flown [illegible]00 hours, SoC 20/2/1961 – parts to RAE. 4/3/1962 By [illegible] to Foulness Island for breaking up.

One Valiant B Mk.2 prototype ordered under Contract No 6 Air/5957/CB.6(c). Serial allotted 1/11/50.

WJ954 Type 673. f/f 4/9/1953, 6-12/9/1953 Loan to V-A for SBAC Show, 19/12/1953 accepted off contract – V-A development flying, 3-14/9/1954 Loan for SBAC Show, [illegible]/1954 Sprite detached in flight, 21/4/1955 Starboard undercarriage collapsed Cat.3(R), 29/8/1955 Cat.4 repair [illegible] Contract 6/Acft/10141/CB.6(c), 8/3/56 Wisley [illegible]peration for nitrogen system and fuel heater tests [illegible]cated 15/5/56), flew 167.35 hours only. 29/4/57 aircraft [illegible]ressed. SoC 18/3/1958 – allocated PEE Shoeburyness, [illegible]/1958 being dismantled at Wisley by RAF (71 MU staff). [illegible]/1958 fuselage by road to Foulness Island for breaking up.

25 Valiant B Mk.1 ordered under contract 6/Aircraft/6313/CB.6(c) dated 20th April 1951. Serials allotted 8/2/51.

WP199 B 1. f/f 21/12/1953, d/d 18/12/1954 A&AEE Boscombe Down for C(A) clearance trials, 4/4/1955 Wisley – modification for armament trials under C/A/11788/CB.6(b), 23/6/1955 to A&AEE flew 59.15hrs, 15/6/1956 Wisley from A&AEE for TI mods C/A/13432/CB.24(b) (59.15 flight hours a A&AEE), 23/11/1956 Marshalls of Cambridge (= V-A at Marshalls) for refurbish and mods. to C/A/14327/CB.24(b), 30/8/1957 Avro for Inertial Navigation System fit re Blue Steel development C/A/14470/CB.6(a) (allocation only, canc. 23/1/58), Used on Radar NBS trials, 4/9/1959 Martin Baker, Chalgrove for fit of rearward ejection seats – Contract KM/X/03/CB.22c, 1/7/1960 Marshalls of Cambridge for storage, 27/6/60 allotted BCDU Finningley – canc. 27/7/60, aircraft released, 10/10/1960 Allotted Bristol Siddeley Engines as BE.53 flight test-bed Contract KG/2Q/02/CB.12(a), re-allotted to Marshalls for servicing; 3/1/1961 To Bristol Siddeley Filton from Cambridge, fitted Bristol Siddeley BS53 Pegasus vectored thrust engine, 24/3/1963 f/f with BE.53 installed, 26/11/1964 trials completed, 15/3/1966 Sold B A Taylor Ltd, 22/4/1966 SoC.

WP200 B 1. f/f 9/3/1954, A&AEE 25/3/1954, Wisley 31/3/1954, RRE Gaydon 22/12/1954 from Wisley on RRE NBS/H2S Mk.9 trials, 8/2/1955 Wisley for preparation for bombing trials 6/Acft/11717/CB.6(c), 23/3/55 Wisley to A&AEE en route Defford, 28/3/1955 Defford, 17/11/1955 Wisley for mods and preparation for NBS trials 6/Acft/12793/CB.6(c), 4/1/1956 Gaydon (for Defford), 8/2/1956 Vickers mods. 13/2/1956 Dinghy hatch lost and hit tail plane, tail plane damaged and repaired on site (complete 23/4/56), 28/5/1958 Special Installation fitted, 30/10/1959 engine failure after take-off but landed safely, 14/3/1961 Abandoned take-off, overshot and crashed, Cat.5 and SoC (MoA) 4/8/1961. 9/10/1961 SoC (RAF) at 71 MU. To RAF Catterick for fire-fighting to destruction.

WP201 B 1. f/f 13/4/1954, d/d 21/12/1954 to C(A) charge 1321 Flight Farnborough special armament trials, 15/6/1955 1321 Flight Wittering special armament trials, 19/9/1955 Wisley, 3/10/55 Wittering to Wisley V-A rigging and power control tests 6/Acft/12081/CB.6(c), 24/10/1955 Wittering, 19/7/1956 Farnborough armament & navigation trials, 14/4/1956 RAE for OR.1182 navigation trials, Wittering, 1/5/1958 re-allotted RAE for R & D on flutter, vibration and loading trials, 28/7/60 aircraft released, 28/11/1960 To RAF St Athan as Instruction Airframe 7707M.

WP202 B 1. f/f 19/6/1954, Inspected by HRH Duke of Edinburgh at Wittering 15/7/1954, d/d 31/12/1954 to Farnborough for radio trials, 29/3/1955 to A&AEE for radio trials, 31/5/1955 Wisley to fit NBS Mk.1, 5/7/1955 Gaydon for RRE Defford for Green Satin clearance, 12/8/1955 Boscombe Down, 7/12/1955 damage to nearside port flap, 9/1/1956 RAE Farnborough flight instrument tests, Crashed near Brighton 11/5/1956 Cat.5(s) F.A., Formally SoC 18/4/1957 as Cat.59s).

WP203 B 1. f/f 26/7/1954, d/d 17/12/1954 to RAE Farnborough – inspection at RAE, 22/12/1954 Wisley for V-A flight resonance and aileron control system tests, 20/4/1955 Damaged taxying accident – repair under 6/Acft/14671/CB.6(c), 18/10/1955 Farnborough bombing trials with 10,000 lb bomb, 20/12/1957 Wisley temporary storage, 28/3/1958 Ground vibration trials of Blue Danube and Red Beard under Contract 6/Projects/8234/CB.35(N), commenced 6/6/1958, 11/7/1958 A&AEE for ground vibration trials, 30/7/1958 special trials, 28/12/1960 A&AEE runway friction tests, taxying only to check coefficient of friction on rear wheels of bogies on wet runways, 2/2/1961 Cat.5 (GI) as Instructional Airframe 7713M, 3/7/1961 RAF Yatesbury by road (nose only). To Lyneham for fire-fighting training (allotted 23/9/65).

WP204 B 1. f/f 9/9/1954, d/d 4/4/1955 Handling Squadron, Boscombe Down, 1/6/55 All four engines changed to Type 204, 30/9/1955 Vickers for generator behaviour trials at altitude 6/Acft/12879/CB.6(a), 2/11/1955 Wisley to C(A) charge, 19/10/1956 Boscombe Down, 24/1/1958 MFS Cambridge mods for Blue Steel trials under 6/Acft/15393/CB.6(a) (changed to 6/Acft/14455/CB.6(c) three days later), 6/2/58 Wisley to Cambridge, 2/2/59 V-A preliminary trials, 25/2/1959 Wisley, 29/5/1959 allotted Avro, 19/6/1959 Avro Woodford for flight trials under KD/2/030/CB.6(a), 15/9/1960 departed Woodford for Edinburgh Field for Blue Steel development under KD/2/041/CB.6(a), 21/9/1960 arrived RAAF Edinburgh Field, 27/9/60 Base Squadron, Edinburgh, 19/12/61 allotted Avro for check after trials, 4/1/1962 arrived UK(?), 9/1/62 arrived Woodford, [11/1/62 to UK according RAAF records], 15/4/62 allotted 7753M, location stated as 'A.V.Roe Woodbridge', 1/6/1962 Instructional purposes 4 SofTT St Athan Cat.5(GI). Allotted 7753M 3/7/62.

WP205 B(PR) 1. f/f 8/10/1954, d/d 14/3/1955 Gaydon, 19/3/1955 Gaydon inspected by US, 21/3/55 Gaydon to Wisley free loan to C(A), 24/3/1955 conversion to B(PR) Mk.1 under Contract 6/Acft/9778/CB.6(a), A&AEE 14/7/1955 Boscombe Communications Flying, night flying trials, 13/9/55 to Boscombe for PR trials, 15/9/1955 Tropical trials at RAF Idris, 9/11/1955 Farnborough, 22/11/1955 Wisley for repair after damaged in forced landing at RAE, 9/12/55 Cat.4R repair under Contract 6/Acft/12915/CB.24(b), 27/2/1956 V-A Night Photographic trials 6/Acft/9778/CB.6(C), A&AEE 26/7/1956, 11/9/56 to Wisley for V-A servicing, modification, radio and nav. fit (6/Acft/9778), To Australia 19/10/1956 for A&AEE PR trials, Left Australia 5/3/1957, El Adem 9/7/1958, 26/8/1957 damaged, faulty undercarriage, Malta 26/11/1958, 24/12/58 V-A 200 hour inspection and mods. 6/Acft/15399/CB.24(b), 2/1/1959 to Wisley, A&AEE 20/2/1959 for night PR trials, 31/5/59 transferred to C(A) on repayment, Wisley 11/9/1959 for V-A Mod. 2779 under Contract KD/9/024, 17/11/1960 overshot runway and hit runway control caravan, extensive damage to pressure cabin and port inner mainplane, SoC 16/7/1961 – components to RAE Structural and Mechanical Engineering Dept.

WP206 B 1. f/f 3/11/1954, d/d 8/2//1955 138 Squadron Gaydon, 31/8/1955 Wittering detached for 'Too Right', 12/1/1956 138 Squadron Wittering, 5/6/1956 49 Sqdn Wittering, To Marshalls of Cambridge 2/4/1957 for inertial navigation fit on Blue Steel development 6/Acft/14470/CB.6(A) – free loan to C(A), 18/7/57 V-A at Marshalls for trial installation of Blue Steel, 9/1/58 Avro at Marshalls inertial navigation system re Blue Steel 6/Acft/14470, 15/5/58 Cambridge to Avro Woodford for flight trials, transferred to C(A) without charge (exchange for WP218), No 2 Air Trials Unit 12/6/1958, Maintenance Squadron, Edinburgh for mods 23/7/1958, 2 ATU 6/8/1958, Maintenance Squadron Edinburgh 12/2/1960, 4/3/1960 2 ATU, 26/8/60 (week ending) despatched to Marshalls, Cambridge (RAAF record), 12/10/1960 Avro to Marshalls for major servicing (Woodford to Cambridge). Left UK 12/10/1961 for Edinburgh Field RAAF development trials

under KD/2/049/CB.6(a) on Blue Steel, arr Base Squadron 17/10/1961, still there 18/10/1962, to UK 27/5/1963 (RAAF record) – Edinburgh Field to Woodford for inspection KD/2/066/CB.(a), 5/12/63 Transferred from HS Dynamics to HS Aircraft Ltd for removal of components for testing, Cat.5, Sold 16/2/1964 to BKL Alloys, Birmingham.

WP207 B 1. f/f 1/12/1954, d/d 19/2/1955 138 Squadron Gaydon, 31/8/1955 'Too Right', 13/10/1955 Gaydon, Wittering 49 Sqdn 21/11/1955, Waddington, 49 Sqdn 5/6/56, 7 Sqdn 15/1/1957, 5/9/1957 Finningley Mod Centre, 7 Sqdn Honington 30/10/1957, MFS 1/10/1958 for mods, 7 Sqdn Honington 18/11/1958, 10/12/1958 respray, MFS 24/11/1959, 7 Sqdn Honington 4/1/1960, 7 Sqdn Wittering 3/8/1960, 232OCU 31/8/1961 at 1,637.00 flying hours, 24/5/62 232 OCU, Vickers Hurn for mods 12/6/1962, Ex-mods – 232 OCU 29/8/1962, Cat 3R repair on site 12/12/1962, 1/1/1963 232 OCU, 4/6/1964 Cat 3R repair on site by 60 MU, 17/8/1964 232 OCU Gaydon, 30/6/1964 Cat.3, 19 MU 20/11/1964, 18/2/1965 Non-effective aircraft, 1/1/1967 Sold Bradbury & Co Bournemouth.

WP208 B 1. f/f 24/12/1954, 10/2/1955 Allotted A&AEE Boscombe Down for development work, delivered 20/2/55, Wisley 22/2/1955, Allotted V-A for autopilot trials under 6/Acft/11540 & 10603/CB.6(c), 11/7/1956 A&AEE autopilot trials, 15/8/1956 Wisley, 29/11/1956 to A&AEE for armament trials under 6/Acft/13923/CB.6(c), Rear crew escape trials 17/7/1958 (armament trials temporarily suspended), 27/2/1959 MFS for incorporation of CA release mods under 6/Acft/15364/CB.24(b), 23/10/1959 A&AEE clearance 1,000 lb (mines?), special weapon safety trials and prolonged loading trials No 3 Mk.3 EM release unit. Hurn 3/10/60 for minor inspection, Dinghy hatch cover blew off during take-off 19/12/1960, Hurn to A&AEE 20/2/61 to continue armament clearance, aircraft released 8/3/61, to Filton 12/5/61 for mods under Contract KK/G/0294/CB.24(b), 2/6/61 Vickers mods, mid-1961 believed used to test TSR.2 sideways-looking radar, 7 Sqdn 18/5/1962, 10/10/1962 19 MU, 6/3/1964 Non-effective aircraft, 16/6/1965 Sold scrap Marine Salvage Ltd.

WP209 B 1. f/f 8/1/1955, d/d 6/4/1955 Farnborough, 07/04/55 Wisley to Farnborough – inspection re bomb ballistics trials. To C(A) charge, 13/4/1955 RAE to Wisley for V-A instrumentation and mods under contract 6/Acft/11586/CB.6(b), 20/7/1955 to RAE for bomb ballistics trials, Left for LRWE Woomera (ARDU Trials Flight) 31/7/1955 (making London-Baghdad @ 523.5mph, Singapore-Darwin @ 518.4mph), Air Trials Unit 11/8/1955, 10,000 lb MC bomb trials, 16/11/1960 Arrived Cambridge ex-Edinburgh Field. TI of mods under Contract KD/P/0113/CB.6(b), 22/8/1961 Allotted for mock-up and TI's (KD/P/0132), pre-gassed fuel trials (KD/P/095), rapid disconnection design study (KD/P/0127) & rapid disconnection development (KD/P/0138/CB.42(a)), 10/1/1962 Loaned to RAE Bedford for flight trials under Contract KD/P/095/CB.42(a), 28/08/62 Trials under Contract KD/P/0124/CB.24(a), Cambridge to Boscombe Down for TACAN aerial trials 18/3/1963, MFS 25/4/1963 for TI of mods – KD/P/0158/CB.42(a), Stansted fire-fighting at FSTS 5/8/1963, SoC 8/9/1966.

WP210 B 1. f/f 27/1/1955, d/d 1/4/1955 A&AEE Boscombe Down for inspection and acceptance, Loan to C(A). To Vickers Wisley 13/4/1955 for V-A generator cooling and handling trials with bomb doors open (Contract 6/Acft/11903/CB.6(c). 3/11/1955 Canopy lost in flight due to inadequate fixing of bolts, 14/5/1956 A&AEE, 8/8/1956 A&AEE U/W tank trials, 8/1/1957 re-allotted for survey of Dectra and Green Satin; used for long period on Operation 'Decca/Dectra' which comprised many trial sorties of Decca and VOR/DME navigation systems over the North Atlantic. Wisley 3/6/1957, detached Canada 9/10/1957, Canada 2/4 – 9/4/1958. Wisley 26/6/1958 for V-A mods (6/Acft/15364/CB.24(b)) prior to return to RAF Service. 49 Sqdn 2/1/1959 ('N/L 32 MU' ?), 19/10/1959 32 MU special fit, 29/3/1960 138 Squadron, 11/5/1960 Hurn (mods), 15/6/1960 138 Sqdn, Hurn mods 27/6/1961, 207 Sqdn 22/8/1961 to 28/6/1964 (Marham Wing 10/3/64 – 49, 148 & 207 Squadrons)), 18/2/65 Cat.5(c), SoC 1/3/1965.

WP211 B 1. f/f 16/2/1955, d/d 16/4/1955 138 Sqdn Wittering, 30/4/1955 Cat 3R FA, 20/8/1955 138 Sqdn, 22/3/1956 214 Sqdn, 9/10/1956 232 OCU Gaydon, 7/11/1956 214 Sqdn, 22/8/1957 Finningley Mod Center, 15/10/1957 214 Sqdn, 18/11/1957 232 OCU, 16/4/58 Vickers, repair on site, (6/Acft/15805), 7/7/1958 199 Sqdn, Honington, 1/10/1958 RCM mods, 17/12/1958 18 Sqdn, 31/12/1958, 3/4/1963 19 MU, 6/3/64 Non-effective aircraft, 21/6/1966 Sold scrap Bradbury & Co.

WP212 B 1. f/f 14//3/1955, d/d 16/4/1955 138 Sqdn Gaydon, 5/7/55 Disposal account – repair on site by Vickers (6/Acft/11870), 12/8/55 138 Sqdn, Wittering 21/11/1955, 21/2/1956 Cat.3R FA, 2/3/1956 Repair in Vickers works, 9/3/1956 138 Sqdn, 6/4/1956 214 Sqdn, 29/8/1956 232 OCU Gaydon, 14/11/1956 214 Sqdn Marham, 26/11/1957 232 OCU Gaydon, 17/12/57 (or 14/1/1958) 199 Sqdn, 16/5/1958 Detached to Idris, Libya, Watton for RCM fit, 199 Sqdn 9/7/1958, 18 Sqdn 16/12/1958, 4/4/1965 19 MU, 23/4/65 Non-effective aircraft, 1/1/1967 Sold scrap Bradbury & Co.

WP213 B 1. f/f 18/3/1955, d/d 2/4/1955 138 Sqdn Gaydon, Wittering 6/7/1955, To Watton for installation of special equipment 29/8/1956, 199 Sqdn 29/5/1957, 18 Sqdn 16/12/1958, Watton 18/11/1959 for mods and special fit, 18/4/1963 19 MU St Athan, 23/4/1963 Non-effective aircraft, 6/4/1965 Sold scrap Shackleton & Co (Halifax) Ltd.

WP214 B 1. f/f 28/3/1955, d/d 2/5/1955 Gaydon on Blue Study trials, 7/5/55 handed over to MoS Air Fleet, 19/8/1955 RAE Farnborough – installation and tests of Blue Study, 1/2/1956 Intermediate fitting of Vortex Generators, 14/3/1956 one trip and 28/3/1956 three trips, 9/5/1956 RAE to Wisley for flight test of RCM aerials (6/Acft/13664/CB.6(a)), first flight RCM fitted 10/12/1956 (Fitted with a large RCM cooling air intake on port rear fuselage), next flights on 13th and 27th. To RAE Farnborough 21/10/1957 for flight trials, 3/2/1958 Wisley additional installations and mods under 6/Acft/13664, A&AEE 29/2/1958. 13/8/1958 RAE to Wisley, 26/9/1958 authority for aircraft to fly to Farnborough on 'drop-in' basis while on V-A charge for further trials of RCM equipment, 30/9/1958 Wisley to Farnborough 'drop-in', 28/12/1958 to A&AEE for CA release trials in RCM role. 138 Sqdn Wittering 22/1/1959, 1/6/1959 BCDU Wittering, Wisley 18/12/1959, BCDU Finningley 14/7/1960, 2/12/1960 Vickers, 2/10/1961 BCDU. To Farnborough as tanker for trials of flight refuelling, BCDU 19/1/1962; Dismantled at Duxford. 28/5/1964 SOC Cat.5(GI) with spares recovery by 60 MU. Airframe to Catterick, 7846M (allotted 25/5/1964).

WP215 B 1. f/f 6/4/1955, d/d 30/4/1955 Gaydon, 6/5/1955 138 Sqdn Wittering 16/9/1957 199 Sqdn Honington, 199 Sqdn Watton 3/3/1958, 10/9/1958 Cat.3R FA, RoS Vickers, Repainted and RCM fitted, 20/7/1959 18 Sqdn, detached Cyprus 8/11/1960, MFS for repairs 22/9/1961, 32MU St Athan 2/12/1961, 18 Sqdn 19/1/1962 (or 11/12/1961), 19 MU St Athan, 2/4/1963, 23/4/1963 non-effective aircraft, 16/6/1965 Sold scrap Marine Salvage Ltd.

WP216 B 1. f/f 18/4/1955, A&AEE 23/5/1955, Wisley 24/5/1955, d/d 6/6/1955 138 Sqdn, 232 OCU Gaydon 20/7/1955, 18/10/1955 Cat.3R Vickers repair in works, 19/1/1956 232 OCU, Hemswell 16/4/1957, 21/6/1957 7 Sqdn Honington, Watton 28/10/1957, Honington 199 Sqdn 14/2/1958, Respray at Cottesmore 13/7/1958, 17/12/1958 Finningley (became) 18 Sqdn, Watton 26/5/1959 Mods, 19 MU, nose at 2RS Yatesbury Sept. 1961. 17/4/1963 19 MU, 23/4/1965 non-effective aircraft, 16/6/65 sold Marine Salvage Ltd.

WP217 B(PR) 1. f/f 27/4/1955, d/d 11/5/1955 Gaydon 543 Sqdn 'A' Flt, 543 Sqdn Wyton 22/11/1955, 207 Sqdn Waddington 8/8/1956 (or 25/7/1956), Marham 207 Sqdn 12/9/1956, 20/9/1957 Finningley Mod Centre, 14/11/1957 207 Sqdn, 21/10/1958 MFS, 15/12/1958 207 Sqdn, 12/1/1960 Vickers mods, 9/2/1960 207 Sqdn, 15/2/1960 7 Sqdn Wittering, 26/7/1960 7 Sqdn Honington, Gaydon 232 OCU 21/11/1960 (or 6/12/1960), 28/5/1961 Vickers mods, 11/10/1961 Ex-mods. Filton mods 17/9/1962, 232 OCU 22/11/1962 (or 30/12/1962), 6/8/1964 while airborne experienced loud bang – a/c landed safely & not flown again. 7/8/1964 Cat.5(c) FA, 17/8/64 SoC.

WP218 B 1. f/f 7/5/1955, d/d 21/7/1955 handed over to MoS Air Fleet at V-A Wisley TI of modifications. Installation of Super Sprite RATOG (in addition to WB215) 23/8/1956, 31/1/1957 TI and FR probe being fitted, A&AEE 13/8/1957, Wisley 25/8/1957, A&AEE 12/8/1957, Wisley 25/9/1957, 6/3/1958 re-allotted RATOG trials following long and short-range ferrying trials under 6/Acft/14236/CB.6(a). De-icing trials 8/11/1958, Rolls-Royce at Wisley for investigation of compressor blade failure under KG/F/08/CB.13(a) 27/11/1958, 21/1/1959 V-A for incorporation of CA release mods (Contract 15364/CB.24(b)). 49 Sqdn 22/7/1959, Hurn (Vickers) mods 11/4/1960, Wittering 49 Sqdn 13/6/1960, Filton mods 1/6/1961, Marham 49 Sqdn 5/7/1961, 32 MU 1/5/1963, 20/8/1963 Vickers mods, 22/10/1963 Ex-mods, Filton for camouflage mod. 3261 5/8/1964, RAF Marham 20/8/1964, 28/8/1964 Disposal account Cat.3R, 21/10/64 Marham Wing (49, 148 & 207 Sqdns), 16/2/1965 Cat.5(c) Disposal account, 1/3/1965 SoC.

WP219 B(PR) 1. f/f 13/5/1955, d/d 16/6/1955 543 Sqdn Gaydon, 12/2/1956 543 Sqdn Wyton, 207 Sqdn 26/6/1956, 1/8/1956 Cat.3R FA, 207 Sqdn Marham 6/9/1956, 21/8/1957 Cat.3R FA (Malta), 26/8/1957 Marham (presumably ferried to Marham for repair), Finningley Mod Centre 5/9/1957 Cat.3 repair, Marham 207 Sqdn 6/12/1957, MFS 30/9/1958, 21/11/1958 207 Sqdn, 19/1/1960 MFS mods, 23/2/1960 207 Sqdn, 25/2/1961 Vickers, Bristols 24/5/1961 mods, Marham 207 Sqdn 23/6/1961. Arrived RAE Farnborough 2/7/1962 from 207 Marham for TI and flight trials of 2,100 lb weapon installation (re 25 lb practice bombs), 207 Sqdn Marham 8/3/1963, Filton 15/3/1963, Marham 207 Sqdn 6/6/1963, A&AEE release trials of 25 lb practice bombs 25/11/1963, 207 Sqdn Marham 10/12/1963, 18/2/1965 Disposal account Cat.5(c). On 207 Sqdn till 1/3/1965 when SoC; then scrapped at RAF Marham.

WP220 B 1. f/f 23/5/1955, d/d 22/6/1955 138 Sqdn Gaydon, Wittering 6/7/1955, NBS fitted 27/7/1956, 138 Sqdn Wittering, Detached 'Sunspot' 3/4 – 11/4/1958, 1/12/1958 MFS mods, 138 Sqdn 2/3/1959, Hurn mods 23/5/1960, Wittering 138 Sqdn 23/6/1960, 7 Sqdn Wittering 7/12/1960 232 OCU 1/8/1961, 7 Sqdn Wittering 17/3/1961, 232 OCU 31/7/1961, 7 Sqdn 4/5/1962 (or 18/5/1962), 32 MU 15/10/1962, 9/11/1962 Non-effective aircraft, 16/6/1965 Sold Marine Salvage Ltd.

WP221 B(PR) 1. f/f 27/5/1955, 24/6/1955 543 Sqdn Gaydon, 543 Sqdn Wyton 22/11/1955, 207 Sqdn Marham 18/6/1956, Finningley 22/11/1957, Marham 20/12/1957, Respray 31/5/1958, MFS mods 23/2/1959, 8/4/1959 Vickers Cat.4 major servicing – repair in works. 207 Sqdn Marham 19/5/1959, 2/5/1960 Vickers mods, 13/6/1960 207 Sqdn, Detached 'Sunspot' 11/8/1960, Vickers 17/4/1961, 207 Sqdn 9/6/1961, Vickers 12/10/1962, 207 Sqdn 18/12/1962, Bristol respray 20/2/1964, On 207 Sqdn (Marham Wing) 6/3/1964 19/2/1965 Cat.5(c), SoC 5/3/1965 to P&EE Shoeburyness

WP222 B 1. f/f 10/6/1955, 30/6/1955 232 OCU, 22/7/1955 138 Sqdn Wittering, 29/7/1955 Crashed Wittering after take-off – a/c turned to port, nose dropped, angle of bank increased to 60° and aircraft crashed (cause runaway trim tab actuator at extreme range of its travel; a modification later introduced to limit the tab travel). SoC 30/8/1955.

WP223 B(PR) 1. f/f 20/6/1955, d/d 20/7/1955 543 Sqdn Gaydon, 2/11/1955 Vickers Cat.4 (rogue) – investigation 543 Sqdn Wyton 28/11/1955, A&AEE 24/1/1956, Wyton 2/2/1956, Marham 214 Sqdn 7/5/1956, 90 Sqdn Honington 27/5/1957, Respray 31/5/1957, 21/6/1957 Cat.3R FA, 29/9/1957 90 Sqdn, 14/7/1958 MFS mods, 15/9/1958 90 Sqdn Honington, Hurn mods 14/7/1959, Honington 90 Sqdn 11/8/1959, Wittering 7 Sqdn 2/4/1960 (or 19/7/1960), 30/8/1960 7 Sqdn Wittering, Wyton 543 Sqdn 17/10/1962 29/10/1962 Cat.3R FA RoS, 71 MU, 23/1/1963 543 Sqdn Filton 25/4/1963, Wyton 543 Sqdn 29/8/1963, 19/2/1965 Disposal account Cat.5(c), 3/3/1965 SoC.

24 Valiant B Mk.1 ordered to contract 6/Aircraft/7375/CB.6(a) dated 1st October 1951. Serials allotted on 12/11/52.

WZ361 B.1. f/f 27/6/1955, d/d 12/8/1955 232 OCU Gaydon, 27/2/1956 Cat.3R FA, repair in Vickers works 30/4/1956 232 OCU, Finningley 30/12/1957 mods, Gaydon

232 OCU 11/3/1958, 27/4/1959 MFS mods, 27/7/1959 232 OCU, Hurn 29/8/1960, (another source states went to English Electric for mods until 28/9/1960), 232 OCU 29/10/1960, 27/3/1962 Disposal account Cat.3R, repair on site 71 MU, 4/5/1962 232 OCU, 3/8/1962 207 Sqdn, 25/4/1963 19 MU RAF St Athan for storage, 9/5/1963 non-effective aircraft, SoC 16/6/1965 sold scrap Marine Salvage Ltd.

WZ362 B.1. f/f 4/7/1955, d/d 29/7/1955 232 OCU Gaydon, 24/6/1957 148 Sqdn, 26/7/1957 232 OCU, 7/8/1957 Fitting NBS, 27/2/1959 MFS for mods, 6/5/1959 232 OCU, 13/6/1960 Hurn mods, 18/7/1960 232 OCU, 25/8/1961 BCDU Finningley, 1/5/1962 19 MU St Athan, 9/11/1962 non-effective aircraft, SoC 16/6/1965 and sold for scrap.

WZ363 B.1. f/f 16/7/1955, d/d 19/8/1955 138 Sqdn, 6/11/1957 detached 'Goldflake', MFS 9/12/1958 for mods, 138 Sqdn Wittering 5/2/1959, Hurn mods 30/5/1960, 138 Sqdn 28/6/1960, Hurn mods 31/5/1961, 17/7/1961 148 Sqdn Marham, 11/12/1961 Vickers mods, 28/2/1962 148 Sqdn. 6/5/1964 while on loan to 207 Sqdn crashed at Market Rasen after completing night overshoots at RAF Binbrook. After normal roller landing it climbed away normally but crashed shortly afterwards (cause – possibly runaway tailplane actuator). Crew were Ft Lt F C Welles, Ft Lt G A Mills, Ft Lt J R Stringer, Ft Lt L R Hawkins and Sgt R Noble. Aircraft flew 2,340.05 hrs. 7/5/1964 Cat.5(s), 8/5/1964 SoC.

WZ364 B.1. f/f 20/7/1955, d/d 26/8/1955 232 OCU, Finningley 14/1/1958, Gaydon 24/3/1958, MFS 7/10/1958, 232 OCU 1/12/1958, 27/7/1959 Vickers mods, 26/8/1959 232 OCU, 11/5/1962 19 MU St Athan storage. Non-effective aircraft 22/3/1963. Sold scrap B A Taylor (Metals) Ltd. 26/11/1964.

WZ365 B.1. f/f 3/8/1955, d/d 22/9/1955 232 OCU, Farnborough Show 4/9 – 12/9/1955, canopy separation 5/6/1956, 17/6/1957 199 Sqdn, RAF Watton 21/6/1957 (or 7/7/1957) for installation of special equipment, 199 Sqdn 11/1957, 4/9/1958 Cat.3R FA, RoS Vickers, 25/1/1959 18 Sqdn Finningley, 22/6/1959 MFS (Vickers) repair in works, 9/10/1959 18 Sqdn Finningley, 19/4/1963 19 MU St Athan storage, 6/3/1964 non-effective aircraft, 16/6/1965 Sold scrap Marine Salvage Ltd.

WZ366 B.1. f/f 18/8/1955, d/d 7/10/1955 Waddington Station Flight, 27/10/1955 Wittering Station Flight, 3/3/1956 138 Sqdn, 14/5/1956 49 Sqdn, To Australia on 'Buffalo', 11/10/1956 dropped first British Atom bomb (Blue Danube) over Maralinga (Sqn Ldr Flavell), 11/1/1957 Honington 7 Sqdn. Finningley mods 26/4/1957, Honington 7 Sqdn 12/7/1957, MFS 29/8/1958 for mods, 18/10/1958 Honington 7 Sqdn, 7/9/1959 Vickers mods, 9/10/1959 7 Sqdn, 14/6/1960 Cat.3R FA at Luqa, 7/7/1960 39 Sqdn (ex-3R), 12/8/1960 7 Sqdn, 9/10/1961 232 OCU, 9/11/1962 19 MU, 6/3/1964 non-effective aircraft, 16/6/1965 Sold scrap Marine Salvage Ltd.

WZ367 B.1. f/f 30/8/1955, d/d 19/9/1955 RAF Waddington, 27/10/1955 RAF Wittering, 3/3/1956 138 Sqdn Wittering, 25/5/1956 49 Sqdn, Special Equipment calibration 28/5/1956, Detached for 'Buffalo' Atom Bomb tests in Australia, Wittering 2/11/1956, Detached Hemswell, allotted Marham 148 Sqdn 14/12/1956, MFS 10/9/1958 for mods, 28/10/1958 Marham 148 Sqdn, Wittering 49 Sqdn 15/7/1959, MFS 14/9/1959, 148 Sqdn 8/10/1959, 25/5/1961 Vickers, 27/7/1961 148 Sqdn, 12/11/1962 Vickers (Filton) mods, 12/2/1963 148 Sqdn, 21/10/1964 BAC Cat.4R, 6/5/1965 Cat.5(c), 10/6/1965 SoC as scrap.

WZ368 B.1. f/f 10/9/1955, d/d 25/10/1955 232 OCU Gaydon, 9/1/1956 Cat.3R FA – to Cat.4R & repair in Marshalls' works, 21/4/1956 232 OCU Gaydon, Hemswell 26/9/1956, Gaydon 17/10/1956, 24/3/1958 Finningley, 22/5/1958 Gaydon 232 OCU, 18/11/1958 MFS mods, 7/1/1959 232 OCU, 19/10/1959 Hurn mods, 4/12/1959 232 OCU 9/10/1961 7 Sqdn, Cat.3 71 MU 14/5/1962, 13/7/1962 short term storage at Wittering, 12/10/1962 19 MU St Athan prepared for sale, 9/11/1962 non-effective aircraft, 26/11/1964 sold as scrap B A Taylor Ltd.

WZ369 B.1. f/f 17/9/1955, d/d 25/10/1955 232 OCU Gaydon, 8/5/1957 Marham 148 Sqdn, Finningley 28/6/1957, Marham 21/8/1956, 232 OCU 16/10/1957, MFS 20/4/1959, 232 OCU 26/6/1959, Hurn mods 26/9/1960, 232 OCU 10/11/1960, 31/7/1961 Wittering 7 Sqdn, 22/6/1962 19 MU St Athan storage. 9/11/1962 non-effective aircraft, (2103.30 hours). 16/6/1965 Sold scrap Marine Salvage Ltd.

WZ370 B.1. f/f 22/9/1955, d/d 29/2/1956 handed over to MoS Air Fleet ex-storage V-A Weybridge, 28/3/1956 MFS Cambridge (Avro) mods & TI (Blue Steel; Contract 6/Acft/13351/CB.6(a)), 19/9/1956 Avro Woodford for special armament trials to above contract, 22/7/1957 allotted Blue Steel development at WRE (Contract 6/Acft/14553/CB.6(A)), To RAAF 16/8/1957, 29/6/1959 Avro at Edinburgh (RAAF record), 22/7/1959 Edinburgh development trials (RAAF record), 9/11/1959 to UK (RAAF record) – despatched Edinburgh Field to Woodford (MoS record), arrived Woodford 17/11/1959 de-instrumentation by Avro (Contract KD/2/027/CB.6(A)), 14/12/1959 to Wisley for de-icing trials & development work (Contract KD/P/0101/CB.6(C)), 14/10/1960 authority to move to Weybridge, Hurn de-icing mods 21/10/1960, 16/5/1961 Hurn to Pershore for Stage B approval of OR.3600 equipment and Addendum to OR.3510 equipment, 1/11/1963 aircraft released, 7/9/1964 released from standby, pressure cabin to RAE. SoC 15/2/1966.

WZ371 B.1. f/f 1/10/1955, d/d 4/11/1955 232 OCU Gaydon, 12/11/1957 Finningley Mod Centre, 18/12/1957 232 OCU Gaydon, 30/5/1958 138 Sqdn Wittering, Honington 90 Sqdn, Wittering 9/9/1958, Gaydon 9/12/1958, 13/3/1959 232 OCU, 16/6/1959 MFS, 24/8/1959 232 OCU Gaydon, 18/7/1960 Hurn mods, 232 OCU 12/8/1960, 21/8/1961 Wittering 7 Sqdn, 19/10/1962 19 MU St Athan, 9/11/1962 non-effective aircraft, 16/6/1965 Sold as scrap Marine Salvage Ltd.

WZ372 B.1. f/f 10/10/1955, d/d 29/11/1955 232 OCU Gaydon, 21/6/1957 199 Sqdn, 1/7/1957 RAF Watton, 19/12/1957 Honington 199 Sqdn, 1/1/1959 (or 17/12/1958), 18 Sqdn Finningley 1/4/1963 19 MU St Athan, 23/4/1963 non-effective aircraft, 6/6/1965 Sold as scrap Marine Salvage Ltd.

WZ373 B.1. f/f 18/10/1955, d/d 18/11/1955 Fairey Aviation Cranfield 'Green Cheese' missile including high-altitude high-speed release (Contract 6/Acft/12861/CB.6(a)) C(A) charge, 24/4/1956 to Wisley for V-A preparation for Phase 3 radio and nav. trials at A&AEE. To A&AEE for trials 22/10/1956, 30/9/1957 Boscombe to Weybridge for minor inspection (6/Acft/15399/CB.24(b)), 1/11/1957 A&AEE to continue trials, 18/4/1958 to Wisley for V-A modification for Phase 2 Blue Steel trials (Contract 5/KD/P/065/CB.6(a)), MFS Cambridge 24/4/1958 (or 14/7/1958) for above mods. (same Contract), to Avro Woodford 20/8/1958 (Contract as above). Departed for RAAF Edinburgh Field 27/10/1960, arr 2/11/1960, 3/11/1960 Avro Edinburgh (RAAF record), 16/7/1962 to UK (RAAF record) – despatch to Woodford for inspection (KD/2/058/CB.6(a)), arr UK 21/7/1962, Disposal on site at Woodford 10/1962, 17/6/1963 transferred from HS Dynamics to HS Aircraft for removal of parts for test. Sold to BKL Alloys 16/7/1963.

WZ374 B.1. f/f 27/10/1955, d/d 16/12/1955 232 OCU Gaydon, 3/7/1956 Cat.3R FA, RoS, 54 MU, 19/10/1956 232 OCU, 25/11/1957 Finningley Mod Centre, 232 10/1/1958 232 OCU Gaydon, 31/12/1958 MFS mods, 13/3/1959 232 OCU, Wittering on loan 15/7/1959, Respray 9/9/1959, 30/11/1959 Hurn mods, 5/1/1960 232 OCU, 19/6/1961 Wittering 7 Sqdn, 23/10/1962 19 MU St Athan, 9/11/1962 non-effective aircraft, 26/11/1964 Sold as scrap B A Taylor (Metals) Ltd.

WZ375 B.1. f/f 2/11/1955, d/d 30/11/1955 Vickers, 16/2/1956 A&AEE Boscombe for 'research work' (Contract 6/Acft/12830/CB.6(a)), 23/2/1956 Wisley for replacement of ailerons and elevators, 30/4/1956 A&AEE, 14/1/1957 Cambridge Avro for Special Stores installation (Contract 6/Acft/13351/CB.6), 5/7/1957 Avro Woodford, 25/2/1959 MFS (V-A) for conversion for Blue Steel Phase 2 trials (Contract KD/P/071/CB.6(a)), 2/3/1960 Avro Woodford on Blue Steel development. To RAAF Edinburgh Field arr 30/3/1961, 10/4/1961 Base Sqdn Edinburgh (RAAF record), 12/2/1963 left Australia (RAAF record) Despatched to Woodford (MoS record), 17/2/1963 arr Woodford – de-instrumentation KD/2/058/CB.6(a)), 25/9/1963 MFS major servicing (KK/G/561.CB.24(b)), 25/9/1963 Woodford to Cambridge, 30/10/1963 allotted to RRE for AI radar system and tail warning development trials, Cambridge to RRE Pershore 31/5/1964, 22/7/1966 SoC.

WZ376 B(PR)K.1. f/f 15/11/1955, d/d 29/12/1955 Vickers for conversion to tanker Type 758 for flight refuelling and manufacturer's trials, 23/1/1956 'Air Ministry accepted B(PR)K Mk.1 as a type', f/f as tanker 31/1/1957, trial underwing fuel tanks 16/2/1957, A&AEE 13/5/1957, Wisley 29/6/1957, A&AEE 27/8/1957 refuelling trials, Wisley 25/10/1957, A&AEE 10/1/1958 for flight refuelling trials, Wisley 12/2/1958 (or 5/3/1958) for incorporation of mods before F-R training in service, A&AEE 4/6/1958, Wisley 5/6/1958, Refuelling trials with Scimitar 14/2/1959, A&AEE 9/6/1959 Mk.33 pod, Mk.8 coupling trials Valiant to Valiant and Valiant to Vulcan, 13/7/1959 Wisley, refuelling Canberra WH734 over Sidmouth, 24/7/1959 A&AEE for UHF installation trials, 31/7/1959 V-A at Boscombe Down F-R trials (KD/P/068/CB.6(c)), 31/8/1959 Wisley Primary star inspection (KD/9/026/CB.6(c)), 16/11/1959 A&AEE trials with Vulcan XH478 and Blackburn NA.39, 23/12/1959 MFS mods (KD/9/026/CB.6(c)), 25/1/1960 Wisley to Boscombe, FR trials with Victor, 28/7/1960 A&AEE on site for UHF tropical trials during company's holiday shutdown, 7/3/1961 MFS for safety mods, 2/6/1961 A&AEE trials with Lightning, Wisley 22/6/1961, 2/8/1961 A&AEE for joint A&AEE/CFE trials with Lightning, 27/7/1962 transferred from V-A charge at Boscombe Down to A&AEE. Still there 17/4/1964, 15/3/1965 aircraft released, 19/3/1965 to BAC at Boscombe Down for ground trials of Precision Alignment Datum Equipment, 23/9/1965 ground trials of above, SoC 18/4/1967.

WZ377 B(PR).1. f/f 23/11/1955, d/d 29/12/1955 Wyton 543 Sqdn, 9/2/1956 Gaydon 232 OCU, 14/3/1956 543 Sqdn, 26/3/1956 214 Sqdn Marham, Hemswell mods 16/4/1957, Marham 19/6/1957, Honington 90 Sqdn 13/11/1957, Finningley 27/2/1958, Honington 90 Sqdn 22/4/1958, 22/12/1958 MFS mods, 19/2/1959 90 Sqdn, 13/3/1959 Cat.3R FA, RiW Vickers, 22/6/1959 90 Sqdn, 18/1/1960 MFS mods, 15/2/1960 90 Sqdn, 19/7/1960 7 Sqdn Honington, 26/7/1960 7 Sqdn Wittering, 18/8/1961 232 OCU, Filton mods 4/7/1963, 232 OCU 9/10/1963, 26/11/1964 Marham (49/148/207 Sqdns), 18/2/1965 Cat.5(c), 1/3/1965 SoC.

WZ378 B(PR).1. f/f 28/11/1955, d/d 4/1/1956 214 Sqdn, 2/7/1956 Wittering 49 Sqdn, 30/11/1956 Honington 7 Sqdn, Hemswell fit NBS, 16/5/1957 Honington 7 Sqdn, 22/12/1958 MFS mods, 23/2/1959 7 Sqdn, 6/7/1960 Hurn mods, 3/8/1960 7 Sqdn, 12/10/1962 19 MU St Athan, 6/3/1964 non-effective aircraft, 16/6/1965 Sold as scrap and broken up by Marine Salvage Ltd.

WZ379 B(PR).1. f/f 3/12/1955, d/d 3/1/1956 232 OCU, 11/1/1956 Marham and to Gaydon (214 Sqdn), 18/1/1956 232 OCU, 15/3/1956 Marham 214 Sqdn, 14/6/1957 Finningley mods, 16/8/1957 Marham, 16/12/1957 148 Sqdn, 27/8/1958 MFS, 14/10/1958 Marham 148 Sqdn, 7/3/1960 Hurn mods, 12/4/1960 148 Sqdn, 18/4/1961 Filton mods, 31/5/1961 148 Sqdn, 11/9/1963 Filton, 4/12/1963 148 Sqdn, 10/6/1964 loan to MoA – Marham to MFS for TI of PTR.175, 21/7/1964 Cambridge to A&AEE, 31/8/1964 Boscombe to Marham (49/148/207 Sqdns), 16/2/1965 Cat. 5(c), 1/3/1965 SoC for disposal.

WZ380 B(PR)K.1. f/f 20/12/1955, d/d Wittering 13/2/1956 543 Sqdn, 'Snowtrip' winterisation trials Canada for A&AEE, Wyton 28/12/1956, MFS (Vickers) conversion, 14/3/1957, Wisley 8/5/1957 ex-repair in works, Finningley Mod Centre 4/10/1957, Wyton 543 Sqdn 14/12/1957, MFS mods 9/12/1958, 543 Sqdn 28/1/1959, Hurn mods 25/7/1960, 543 Sqdn 6/9/1960, Hurn mods 10/8/1961, 19/12/1961 543 Sqdn, 21/11/1963 Disposal account Cat.3R, 18/2/1965 Cat.5(c), 3/3/1965 SoC (2470 flying hours).

WZ381 B(PR).1. f/f 23/12/1955, d/d 30/1/1956 (or 12/2/1956) 214 Sqdn, 15/6/1956 Wittering 49 Sqdn, 5/12/1956 Honington 7 Sqdn, Finningley mods 12/7/1957, Honington 7 Sqdn 30/8/1957, 11/11/1958 MFS mods, 20/1/1959 7 Sqdn, 10/2/1960 MFS mods, 11/3/1960 7 Sqdn Honington, 22/7/1960 (or 5/8/1960) 7 Sqdn Wittering, 16/6/1961 232 OCU, 15/5/1962 19 MU St Athan, 9/11/1962 non-effective aircraft, 16/6/1965 Sold for scrap Marine Salvage Ltd.

WZ382 B(PR)K.1. f/f 10/1/1956, d/d 15/2/1956 Wyton 543 Sqdn, 30/8/1956 MFS for mods and conversion, Wisley 1/11/1956, Wyton 543 Sqdn after conversion 10/11/1956, Finningley 26/4/1957, Wyton 543 Sqdn 28/6/1957, 22/12/1958 MFS mods, 24/2/1959 543 Sqdn, 5/10/1959 Vickers Cat.4 M/S and mods, 22/3/1960 543 Sqdn, Filton mods 27/11/1961, 12/3/1962 543 Sqdn, Detached Australia 13/7/1962 to 21/7/1962+, 29/8/1964 Cottesmore mods 6/7/1964, 29/8/1964 Air Show RAF Little Rissington, 3/3/1965 SoC Cat.5(GI) as 7873M at Feltwell (according to AHB card; GI number record book gives 7873M as XD827).

WZ383 B(PR).1. f/f 12/1/1956, d/d 31/1/1956 handed over to MoS; low-flying experiments (6/Acft/12760/CB.6(a)), 30/11/1956 re-allotted for TI of 6,000 lb HE/HC bomb (6/Acft/14033/CB.6(a)), 3/1/1957 7,000 lb and 2,000 lb target marker added to allotment, 6/3/1957 Farnborough for trials, Wisley 15/3/1957, RAE Farnborough 25/3/1957, 2/8/1957 ballistic trials of 2,000 lb TM and 7,000 lb MC stores, Bomb bay deflector torn away on store release 5/10/1957, 8/6/1961 aircraft released – re-allotted for night PR trials, 22/6/1961 RAE to A&AEE, 25/5/1962 re-allotted for Decca/Doppler evaluation, 29/5/1963 Narco (Tony?) Doppler, Litton Platform and solar path gyro trials, 27/5/1964 TSR.2 camera trials (PR variant). SoC for electrical/electronic training 3/9/1965.

WZ384 B(PR).1. f/f 20/1/1956, d/d 2/3/1956 Wittering 138 Sqdn, fitted NBS, 6/11/1957 Detached 'Goldflake', 22/9/1958 Vickers mods, 138 Sqdn 10/11/1958, Detached 'Sunspot' 3/4/1958, MFS 22/9/1958, 138 Sqdn 10/11/1958, Hurn mods 23/2/1960, 138 Sqdn 21/3/1960, Hurn mods 24/5/1961, 148 Sqdn Marham 12/7/1961, Filton mods 27/2/1962, 148 Sqdn 18/5/1962, 17/2/1965 19 MU (4,827 hours flying), 18/2/1965 non-effective aircraft, 1/1/1967 Sold scrap Bradbury & Co.

17 Valiant.B Mk.2 ordered under contract 6/Acft/7376/CB.6(b). Order changed to B Mk.1 later. Serials allotted 1st October 1951.

WZ389 B(PR)K.1. f/f 30/1/1956, d/d 24/3/1956 allotted 543 Sqdn but went to 138 Sqdn instead, fitting NBS 11/4/1956, MFS conversion 6/11/1957 (Contract 6/Acft/13176), 6/5/1958 138 Sqdn, 22/8/1958 detached on 'Grapple', MFS mods 19/1/1959, 138 Sqdn Wittering 14/3/1959, 1/7/1959 detached 'Profiteer', Hurn mods 14/5/1960, 138 Sqdn Wittering 21/6/1960, 11/8/1961 7 Sqdn Wittering, 1/5/1962 Wyton 543 Sqdn, 1/7/1963 (or 6/4/1963) Filton mods, 11/9/1963 ex-mods – to 543 Sqdn, Day Groups 4/10/1963, 32 MU St Athan 6/7/1964, 18/2/1965 Disposal account Cat.5(c), 3/3/1965 SoC.

WZ390 B(PR)K.1. f/f 29/3/1956, d/d 16/4/1956 – to C(A) at Wisley for F-R trials, 25/5/1956 Flight trials with WZ376 using probe and drogue, A&AEE several visits, 8/1/1958 authority to move to Boscombe Down for A&AEE trials, 12/2/1958 Wisley, 8/3/1958 V-A mods, d/d RAF & 214 Sqdn 24/7/1958, Respray 30/7/1958, MFS 22/3/1959 contractor – mods, 214 Sqdn 3/6/1959, Detached Kano 17/6/1959 and 8/7/1959, Idris 14/12/1959 to 8/3/1960+, Hurn mods 27/1/1961, 29/11/1961 Vickers mods, 214 Sqdn 8/2/1962, Cat.3 3/8/1962, 'S' at 32 MU 1/5/1963 to 26/6/1964, 18/2/1965 Disposal account Cat.5(c), 1/3/1965 SoC.

WZ391 B(PR)K.1. f/f 27/2/1956, d/d Wyton 543 Sqdn 28/3/1956, 'Snowtrip' in Canada after 3/10/1956, Wyton 29/12/1956, MFS 12/2/1957 for mods, Wisley 23/3/1957, 543 Sqdn Wyton 1/4/1957, 21/8/1957 Operation 'Antler', Wyton 30/10/1957, Finningley Mod Centre 28/11/1957, Wyton 543 Sqdn 17/1/1958, Respray 4/5/1958, MFS 24/1/1959 for mods (Contract 6/Acft/14309), 543 Sqdn 19/3/1959, Hurn mods 27/6/1960, 543 Sqdn 19/7/1960, Filton mods 26/3/1962, 543 Sqdn 14/6/1962, Day Groups 13/7/1962, 543 Sqdn 18/1/1963, Cat.3 71 MU 19/2/1964, Wyton on 8/1/1965 (4,951 flying hours), 18/2/1965 Disposal account Cat.5(c), 3/3/1965 SoC.

WZ392 B(PR)K.1. f/f 1/3/1956, d/d 4/4/1956 543 Sqdn Wyton, 15/10/1956 MFS conversion (Contract 6/Acft/13176), 543 Sqdn Wyton 7/1/1957, Stbd wing tip damaged 27/2/1957, Operation 'Antler' 21/8/1957, Wyton 30/10/1957, Finningley mods 19/12/1957, Wyton 543 Sqdn 14/2/1958, MFS mods 13/2/1959, 543 Sqdn 4/5/1959, Hurn mods 30/12/1959, 543 Sqdn 25/1/1960. Detached Australia 13/7/1962, Hurn mods 10/9/1962. 543 Sqdn 27/11/1962, Cat.3 71 MU 19/2/1964, Cottesmore 6/7/1964 (2,265 flight hours), 18/2/1965 Disposal account Cat.5(c), 3/3/1965 SoC.

WZ393 B(PR)K.1. f/f 9/3/1956, Allotted 543 Sqdn 21/3/1956, d/d Marham 5/4/1956 214 Sqdn, 90 Sqdn 23/5/1957, Vickers Cat.3R repair in works 11/7/1957, 90 Sqdn Honington 15/10/1957, MFS 5/11/1958 for mods (Contract 6/Acft/14309), 90 Sqdn 26/1/1959, MFS mods 8/3/1960, 90 Sqdn 11/4/1960, Hurn mods 7/3/1961, Marham 148 Sqdn 10/4/1961, Filton mods 13/5/1963, 148 Sqdn Marham 24/7/1963, Filton 13/5/1964, 1/6/1964 camouflaged, RAF Marham Wing 5/8/1964 (49/148/207 Sqdns). Disposal account Cat.5(c) 18/2/1965, 1/3/1965 SoC. GI ledger shows as 7888M, 2/6/1965 allotted to RAF Cosford for radio training.

WZ394 B(PR)K.1. f/f 16/3/1956, d/d Wyton 20/4/1956 543 Sqdn, MFS 10/1/1957 for mods (Contract 6/Acft/13176), Wisley 18/2/1957, Wyton 543 Sqdn 28/2/1957, Finningley 16/8/1957, Wyton 3/10/1957, 543 Sqdn NBS installed, MFS mods 4/5/1959, 543 Sqdn 10/7/1959, Hurn mods 8/9/1960, 543 Sqdn 6/10/1960, detached Australia 13/7 to 21/9/1962, Filton mods 29/1/1963, 543 Sqdn 22/3/1963, 18/2/1965 Disposal account Cat.5(c), 3/3/1965 SoC.

WZ395 B(PR)K.1. f/f 24/3/1956, 214 Sqdn Marham 18/4/1956, MFS 18/4/1957 conversion/repair in works (Contract 6/Acft/13176), Wisley 6/7/1957, Marham 214 Sqdn 29/7/1957, Finningley Mod Centre 6/12/1957, 214 Sqdn Marham 3/2/1958, 148 Sqdn 4/2/1958, Underwing tanks fitted 25/6/1958, 214 Sqdn 23/7/1958, 'Grapple' 3/9 to 10/9/1958, MFS mods 16/4/1959, 148 Sqdn 1/7/1959, Hurn mods 4/4/1960, Marham 148 Sqdn 2/5/1960, Hurn mods 27/6/1961, 148 Sqdn 9/8/1961, Filton mods 24/6/1963, 148 Sqdn 11/9/1963, British Aircraft Corporation Filton 22/4/1964, 214 Sqdn 13/5/1964, 9/1964 Biggin Hill BoB Display. 18/2/1965 Disposal account Cat.5(c), 1/3/1965 SoC.

WZ396 B(PR)K.1. f/f 6/4/1956, d/d Wyton 543 Sqdn 25/4/1956, 30/11/1956 MFS conversion & mods (Contract 6/Acft/13176), Wisley 22/1/1957, Wyton 543 Sqdn 31/1/1957, Finningley Mod Centre 29/11/1957, 543 Sqdn 6/12/1957, Finningley 3/4/1958, 543 Sqdn 6/6/1958, MFS mods 31/4/1959, 15/6/1959 Vickers RiW, 543 Sqdn 4/9/1959, Hurn mods 25/1/1960, 543 Sqdn 17/2/1960, Filton 28/8/1963, ex-mods 543 Sqdn 1/11/1963. Demonstration over Bentwaters USAF base; on return bang heard at 265 knots, vibration, then silence; entire starboard D-door missing off undercarriage. Landed at Manston with wheels up on foam strip; failure to lower main undercarriage 23/5/1964 Cat.5(s) FA. Recat.5(c) 4/6/1964, 28/10/1964 CTE Manston for fire fighting training, 2/11/1964 SoC.

WZ397 B(PR)K.1. f/f 16/4/1956, d/d 1/6/1956 214 Sqdn Marham, 23/8/1956 Bombing trials in USA, MFS 25/7/1957 (Contract 6/Acft/13176), 25/10/1957 214 Sqdn, 15/11/1957 543 Sqdn Wyton, Finningley mods 17/1/1958, Wyton 1/4/1958 543 Sqdn, MFS 2/2/1959 (Contract 6/Acft/14309), 543 Sqdn 23/2/1959 (or 24/3/1959), Hurn mods 5/11/1959, 543 Sqdn 4/12/1959, 13/7/1962 Detached Australia. Filton mods 23/10/1962, 543 Sqdn 31/12/1962, Sept. 1964 Visit to Benson, Biggin Hill, Gaydon, Leuchars & Ternhill; BoB Display (still painted white). 18/2/1965 Disposal account Cat.5(c), 3/3/1965 SoC, 2/6/1965 Allotted 7888M. 14/6/1965 To RAF Cosford for radio training (GI number record book gives 7888M as WZ393!).

WZ398 B(PR)K.1. f/f 21/4/1956, d/d 543 Sqdn Wyton 14/5/1956 – Cat.3R FA on ferry flight (same date), Vickers repair in works 24/5/1956 (Contract 6/Acft/13301), 24/8/1956 543 Sqdn, MFS 24/9/1956 (Contract 6/Acft/13176), 543 Sqdn 19/11/1956, 2/1/1957 'Snowtrip', 1/5/1957 Wyton, 14/6/1957 Finningley Mod Centre, Wyton 16/8/1957 (185 flying hours), 13/9/1957 Exploded in hangar at Wyton, 14/9/1957 Cat.5(s) SoC, 1/1961 Transported by road to scrapyard in Aylesbury, Bicester.

WZ399 B(PR)K.1. f/f 28/4/1956, 5/6/1956 MFS conversion to Receiver standard (Contract 6/Acft/13176), 5/10/1956 543 Sqdn, 1/1957 'Snowtrip', Wyton 1/5/1957, Finningley 14/2/1958, 2/5/1958 Wyton 543 Sqdn, MFS, 3/9/1958 NBS fitted, MFS mods 25/3/1959, 543 Sqdn 14/5/1959, 20/4/1960 Hurn mods, 20/5/1960 543 Sqdn, 3/11/1961 Abandoned take-off at Offutt AFB, Nebraska, USA; overran end of runway, went down steep slope and across main highway before coming to rest on railway embankment; on fire and burnt out but crew survived because cockpit broken off and catapulted across the railway and away from burning aircraft. Cat.5(c) FA, 6/11/1961 SoC.

WZ400 BK.1. f/f 8/5/1956, d/d Wittering 2/6/1956 138 Sqdn, Finningley 3/5/1957, Wittering 5/7/1957, 'Sunspot' 18/4 to 25/4/1958+, MFS mods 30/6/1958 (Contract 6/Acft/14309), Wittering 138 Sqdn 10/9/1958, MFS 31/8/1959, 9/6/1959 BCDU Wittering, 31/8/1959 Vickers mods (Contract KK/G/080), 138 Sqdn 30/9/1959, 1/10/1959 BCDU Wittering, 25/2/1960 BCDU Finningley, 24/11/1961 Trial installation, 4/12/1962 19 MU St Athan, 18/2/1965 Disposal account Cat.5(c), 1/1/1967 Sold as scrap Bradbury & Co Bournemouth.

WZ401 BK.1. f/f 16/5/1956, d/d Wittering 12/6/1956 138 Sqdn, NBS fitting 27/7/1956, 18/10 to 22/11/1957+ on 'Goldflake, Finningley 30/1/1958, Wittering 138 Sqdn 15/4/1958, MFS mods 2/10/1958 (Contract 6/Acft/14309), 138 Sqdn 11/12/1958, 'Sunspot' 9/1 to 6/2/1959+ , MFS 27/10/1959, 138 Sqdn 26/11/1959, Hurn mods 24/4/1961, Marham 7/6/1961 207 Sqdn, 17/12/1962 Filton mods, 28/2/1963 207 Sqdn, 25/7/1963 32 MU major servicing, Filton mods 26/5/1964, 207 Sqdn 9/6/1964, SoC 5/3/1965.

WZ402 BK.1. f/f 25/5/1956, d/d 17/7/1956 Wittering 138 Sqdn, NBS fitted 3/8/1956, Finningley Mod Centre 23/8/1957, 138 Sqdn Wittering 25/10/1957, MFS 30/10/1957 (Contract 6/Acft/14309), 138 Sqdn 28/3/1958, 5/9 to 18/9/1958 'Grapple', MFS 13/10/1958 (6/Acft/14309), 138 Sqdn 1/12/1958, 30/1/1959+ 'Sunspot', Hurn mods 21/3/1960, 138 Sqdn 22/4/1960, Hurn mods 14/2/1961, 207 Sqdn Marham 15/3/1961, Filton mods 4/7/1962, 207 Sqdn 19/9/1962, 21/6/1964 engine change, 14/9/1964 Marham Wing (49/148/207 Sqdns), 18/2/1965 Disposal account Cat.5(c), SoC 1/3/1965.

WZ403 BK.1. f/f 4/6/1956, d/d 27/6/1956 Marham 207 Sqdn, Finningley 5/7/1957, Marham 23/8/1957, 28/8/1957 Fitting NBS, 17/6/1958 MFS mods (6/Acft/14309), 26/8/1958 207 Sqdn, 17/9/1958 Detached Malta, 13/5/1959 MFS Cat.4 major servicing (Contract KK/G/052), 207 Sqdn 1/7/1959, Hurn mods 5/2/1960, 207 Sqdn 7/3/1960, Filton mods 3/1/1961, 207 Sqdn 16/2/1961 (or 1/3/1961), Hurn mods 16/4/1962, 207 Sqdn 7/6/1962, 26/6/1964 detached Cottesmore, 27/7/1964 Marham Wing (49/148/207 Sqdns), SoC 1/3/1965 Cat.5(c), scrapped at Marham.

WZ404 BK.1. f/f 16/6/1956, d/d 30/6/1956 207 Sqdn Marham, Finningley 5/7/1957, Marham 207 Sqdn 12/9/1957 MFS mods 18/8/1958 (6/Acft/14309), 207 Sqdn 14/10/1958 MFS 4/6/1959 Cat.4 M/S, 207 Sqdn 30/7/1959, MFS 26/10/1959, 207 Sqdn 23/11/1959, 11/8/1960+ 'Sunspot' Bristols mods 9/2/1961, 207 Sqdn 16/3/1961, Filton mods 6/6/1963, 207 Sqdn 23/8/1963, Filton 9/6/1964, Marham 23/6/1964 (2,614 flying hours), 18/2/1965 Disposal account Cat.5(c), 1/3/1965 SoC, scrapped Marham.

WZ405 BK.1. f/f 18/6/1956, d/d 17/7/1956 Marham 207 Sqdn, Finningley Mod Centre 20/12/1957, 207 Sqdn Marham 19/2/1958, MFS mods 17/7/1958 (6/Acft/14309), 207 Sqdn 4/10/1958, Hurn mods 30/6/1959 (KK/G/080), 207 Sqdn 30/7/1959, 'Sunspot' 11/8/1960, 3/1961 St Athan, 14/7/1961 207 Sqdn, 138 Sqdn Wittering 6/10/1961, 25/4/1962 (or 24/7/1962) 232 OCU Gaydon, Check 3 30/6/1964 (2,704 flying hours). 18/2/1965 Disposal account Cat.5(c), 4/3/1965 SoC.

56 Valiant B Mk.1 ordered to contract 6/Aircraft/9446/CB.6(c) but only 38 delivered (XD876 to XD893 cancelled). Serials allotted on 20/3/53.

XD812 BK.1. f/f 27/6/1956, d/d 18/7/1956 Marham 207 Sqdn, MFS 4/10/1957 (6/Acft/14309), 214 Sqdn Marham 24/3/1958, Respray 2/4/1958, 23/11/1958 conversion to tanker, MFS 20/2/1959 (6/Acft/14309), 214 Sqdn 6/4/1959 205 Sqdn Marham 26/8/1959, 214 Sqdn 1/10/1959 (or 18/11/1959) – Carried out Flight Refuelling trials with AW

Argosy C.1 at Boscombe Down, Hurn mods 12/7/1960, 214 Sqdn 8/8/1960, Hurn mods 9/10/1961, 214 Sqdn 18/12/1961, 1/5/1963 Detached Wyton for CWP, Engine change 26/6/1964, 18/2/1965 Disposal account Cat.5(c), 5/3/1965 SoC.

XD813 BK.1. f/f 2/7/1956, d/d 18/7/1956 Marham 207 Sqdn, 6/2/1957 Fuselage damaged Cat.3, MFS mods 11/2/1958 (6/Acft/14309), 207 Sqdn Marham 29/5/1958, 4/2/1959 detached South Africa, Hurn 2/6/1959, 207 Sqdn 2/7/1959, MFS Vickers 23/10/1959 repair in works [KK/G/052), 207 Sqdn 20/2/1960, detached 'Sunspot' 1/8/1960, 11/8/1960 Detached 'Sunspot', 16/6/1961 90 Sqdn, Filton mods 24/7/1961, 90 Sqdn Honington 15/9/1961, Filton mods 15/7/1963, 18/10/1963 Marham Wing, 90 Sqdn 7/7/1964, 18/2/1965 Disposal account, 1/3/1965 SoC Cat.5(c).

XD814 BK.1. f/f 10/7/1956, d/d Marham 148 Sqdn 26/7/1956. First V-Bomber to drop bombs in anger on Alamaza 3/10/1956, 13/3/1957 CWP at Hemswell, MFS 23/5/1958, Marham 148 Sqdn 19/8/1958, MFS mods 24/11/1959, 148 Sqdn 22/12/1959, Wittering 138 Sqdn 7/6/1961, Filton mods 14/10/1961, Honington 90 Sqdn 9/1/1962 Camouflaged, 24/2/1964 Honington to MFS Cambridge for TI of Collins STR.18B VHF set (Contract KD/P/190/CB.5(a)), MoA charge 24/4/1964, to A&AEE 4/6/1964 test Collins 618T3, 90 Sqdn Honington 8/7/1964. 26/9/1964 Disposal account Cat.4R, 15/12/1964 SoC Cat.5(c).

XD815 BK.1. f/f 11/7/1956, d/d 17/8/1956 Marham 148 Sqdn, MFS mods 3/3/1958 (6/Acft/14309), Repaint 19/2 to 26/2/1958, Marham 148 Sqdn 11/7/1958, MFS mods 21/8/1959, 148 Sqdn 12/9/1959, 207 Sqdn 19/2/1960, Wittering 138 Sqdn 17/3/1961, 214 Sqdn 4/5/1961, 138 Sqdn 4/7/1961, Honington 90 Sqdn 29/11/1961, Filton 28/5/1962, 90 Sqdn 31/7/1962, 11/2/1963 Marham Wing, 2/8/1963 CWP Cottesmore. At 7/7/1964 flying hours total 2,391, 18/2/1965 Disposal account, 1/3/1965 SoC Cat.5(c).

XD816 BK.1. f/f 25/7/1956, d/d 3/9/1956 Marham 148 Sqdn, MFS mods 5/6/1957 (6/Acft/14309), Marham 214 Sqdn 4/3/1958, respray 15/3/1958, Conversion to tanker 19/11 to 17/12/1958, MFS mods 20/2/1959, 3/4/1959 TI of mods (Eureka/Rebecca), vibration, cooling and aerial tests – Marshalls (KD/P/078/CB.6), 9/4/1959 handed over to C(A) at Marshalls, to Wisley 23/5/1959, Marham 10/6/1959, 214 Sqdn 11/6/1959, Hurn mods 29/1/1962, 214 Sqdn 12/4/1962, Wisley 19/8/1964 Trial installation of rear spar repair scheme under KD/P/198/CB.5(c), 21/9/1964 loan to BAC Wisley, Wisley 1/4/1965, 26/11/1965 re-spar and prep for flight trials (KD/P/207/CB.5(b)), 214 Sqdn, Wisley 31/12/1966 (2,012.5 flight hours & 829 landings), 29/6/1967 BAC (Operating) Ltd – fatigue flight trials, 1/4/1968 aircraft released, MoD free loan for display at RAF Abingdon 29/4/1968, SoC 26/8/1970 parts to RAF Museum.

XD817 BK.1. f/f 27/7/1956, d/d 23/8/1956 Marham 148 Sqdn, MFS 1/4/1958 (6/Acft/14309), 148 Sqdn 4/7/1958, 3/9 to 24/9/58 148 Sqdn detached 'Grapple', Hurn 5/10/1959, 148 Sqdn Marham 4/11/1959, 14/3/1961 90 Sqdn Honington, 28/10/1961 32 MU, Wittering 138 Sqdn 2/12/1961, Filton mods 30/1/1962, 138 Sqdn 7/5/1962, 90 Sqdn 12/10/1962, 90 Sqdn 7/7/1964 (2,289 flight hours), 18/2/1965 Marham Wing. Disposal account Cat.5(c), 1/3/1965 SoC.

XD818 BK.1. f/f 4/9/1956, d/d 14/11/1956 49 Sqdn Marham, 15/3/1957 to 2/5/1958 detached 'Grapple', 15/5/1957 dropped Britain's first H-bomb at Christmas Island (Sqn Cdr Hubbard), returned 23/9/1958. Detached 'Sunspot' 1/9/1959, Hurn mods 21/11/1959, 49 Sqdn Wittering 29/11/1960, detached 'Sunspot' 10/3/1960, Bristols mods 2/1/1961, 49 Sqdn Wittering 8/2/1961, 148 Sqdn, Marham 49 Sqdn 19/5/1961, Hurn mods 16/7/1962, Marham 49 Sqdn 27/9/1962, Airframe repairs 26/6/1964 (2,402 flight hours), Sqdn 1964 camouflaged. 18/2/1965 Disposal account Cat.5(c), 1/3/1965 SoC. 14/10/1965 Marham as 7894M for preservation. Extant RAF Museum, Hendon.

XD819 BK.1. f/f 3/9/1956, d/d 28/9/1956 Marham 148 Sqdn, MFS mods 19/6/1957 (6/Acft/14309), 148 Sqdn Marham 3/2/1958, respray 9/7/1958, 28/7/1958 'SAC Bombing Squadron', 10/9 to 15/10/1958+ detached SAC, 23/10/1958 148 Sqdn, MFS mods 29/10/1958 (6/Acft/14309), 148 Sqdn Marham 18/12/1958, 11/9/1959 32 MU mods, 10/11/1959 ex-mods, Hurn mods 14/12/1959, 148 Sqdn Marham 13/1/1960, Bristol mods 14/3/1961, 148 Sqdn 18/4/1961, Filton mods 15/8/1962, 148 Sqdn 19/10/1962, 12/5/1964 seen camouflaged, 26/9/1964 Disposal account Cat.4R, 3/12/1964 Recat.5(c), 14/12/1964 SoC (Ground Instruction ledger gives as 7872M to Feltwell for NBS training).

XD820 BK.1. f/f 12/9/1956, d/d 3/10/1956 Marham 148 Sqdn, MFS mods 19/3/1958 (6/Acft/14309), Marham 148 Sqdn 30/6/1958, detached Aden 5/11/1958, Hurn mods 17/6/1959 (KK/G/080), 148 Sqdn Marham 16/7/1959, 9/1960 SBAC Show at Farnborough, Honington 90 Sqdn 10/3/1961, 214 Sqdn 2/5/1961, 90 Sqdn 4/7/1961, Hurn mods 1/8/1962, 90 Sqdn 10/10/1962, Marham Wing 11/2/1965, 18/2/1965 Disposal account Cat.5(c), SoC 1/3/1965.

XD821 BK.1. f/f 21/9/1956, d/d 6/11/1956 Marham 148 Sqdn, 17/12/1957 214 Sqdn, 14/3/1958 148 Sqdn, MFS mods 29/4/1958 (6/Acft/14309), 148 Sqdn 23/7/1958, MFS mods 8/4/1959, 148 Sqdn 24/8/1959, Wittering 138 Sqdn 17/7/1961, 2/3/1962 loan to MoA, 7/3/1962 Wittering to MFS to investigate fuel tank collapse (KD/P/0122/CB.42(c)), 138 Sqdn Wittering 29/3/1962, Filton mods 24/4/1962, Gaydon 232 OCU 28/6/1962, 9/1964 seen camouflaged, 19/11/1964 19 MU, 18/2/1965 non-effective aircraft, 30/10/1967 Sold as scrap Bradbury & Co Ltd.

XD822 BK.1. f/f 8/10/1956, d/d 9/11/1956 Wittering 49 Sqdn, 'Grapple' 15/3/1957, 49 Sqdn, 'Grapple' 25/7 to 5/9/1958+, 49 Sqdn, 13/2/1959 'Sunspot', Hurn mods 9/12/1959, 49 Sqdn 8/2/1960, 10/3/1960 'Sunspot', Filton mods 24/4/1961, 49 Sqdn 1/6/1961, Hurn mods 7/11/1962, 49 Sqdn 1/3/1963, 32 MU 26/6/1964, 18/2/1965 Disposal account Cat.5(c), 5/3/1965 SoC.

XD823 BK.1. f/f 19/10/1956, d/d 21/11/1956 Wittering 49 Sqdn, 15/3/1957 'Grapple', Wittering 5/7/1957, 'Grapple' 4/10/1957?, 49 Sqdn, 'Grapple' 25/4 to 2/5/1958, 49 Sqdn, 'Grapple' 22/8 to 19/9/1958+, 'Sunspot' 20/1/1959, Hurn mods 8/6/1959, 49 Sqdn 24/9/1959, Filton mods 30/6/1961, 49 Sqdn 31/7/1961, Filton mods 13/3/1962, Marham 49 Sqdn 30/5/1962, 90 Sqdn 1/8/1962, 11/2/1963 Marham Wing, Filton 25/6/1964, Marham 49 Sqdn 9/7/1964 (2,220.1 flight hours & 855 landings). 18/2/1965 Disposal account Cat.5(c), 1/3/1965 SoC, 1966 broken up Marham.

XD824 BK.1. f/f 31/10/1956, d/d 24/11/1956 Wittering 49 Sqdn, 'Grapple' 15/3/1957, Wittering 5/7/1957, 'Grapple; 25/10 to 23/11/1957, 'Grapple' 28/3 to 2/5/1958+, 'Grapple' 25/7 to 23/9/1958, 'Sunspot' 13/2/1959, 49 Sqdn, Hurn mods 21/1/1960, Wittering 49 Sqdn 28/3/1960, 138 Sqdn 11/4/1960, 7/7/1960 49 Sqdn, Bristols mods 5/1/1961, 49 Sqdn 15/2/1961, 14/11/1961 Cat.3R FA RoS 71 MU, 49 Sqdn 21/12/1961, Filton mods 5/6/1963, 49 Sqdn 29/4/1963, BAC Filton 20/3/1964, 8/4/1964 ex-contractor – 49 Sqdn to 26/6/1964(?). Disposal account 18/2/1965 Cat.5(c).

XD825 BK.1. f/f 10/11/1956, d/d 30/11/1956 Wittering 49 Sqdn. 10/5/1957, 18/4 to 25/4/1958 and 15/8 to 14/9/1958 all 'Grapple', Wyton 543 Sqdn 21/1/1959, 49 Sqdn 8/5/1959, Hurn mods 26/8/1959, 49 Sqdn 9/12/1959, Bristol mods 3/2/1961, 49 Sqdn 7/3/1961, 49 Sqdn Marham 14/7/1961, Hurn 19/9/1962, 49 Sqdn 29/11/1962, Marham 28/11/1962, BAC Filton 8/4/1964, 49 Sqdn 28/4/1964, BAC Weybridge 23/10/1964, 1/4/1965 for inner mainplane repair scheme (KK/G/654/CB.24(b)) (2,351.15 hours flying). 1966 to 7873M, 10/6/1965 SoC.

XD826 BK.1. f/f 15/12/1956, 22/1/1957 to C(A) charge, 9/2/1957 handed over for F-R probe trials with WZ390 (Contract 6/Acft/12791/CB.6(c)), d/d 12/2/1957 Honington 7 Sqdn, NBS fitted 8/3/1957, MFS mods 2/7/1958 (6/Acft/14309), 7 Sqdn 17/9/1958, Hurn mods 11/8/1959, 7 Sqdn 9/9/1959, 19/7/1960 Honington 90 Sqdn, 10/3/1961 Hurn mods, 16/10/1961 Wittering 138 Sqdn, Gaydon 232 OCU 24/4/1962, Filton 5/12/1962, 232 OCU 26/2/1963 to 30/6/1964+ (2,778 flying hours). 543 Sqdn 15/10/1964, 5/2/1965 GI 7872M allotted for NBS training at Feltwell, 4/3/1965 SoC.

XD827 BK.1. f/f 13/12/1956, d/d 10/1/1957 Wittering 49 Sqdn, 'Grapple' 10/5/1957(?), Wittering 28/6/1957, 'Grapple' 9/10 to 22/11/1957(?) and 28/3 to 16/5/1958 and 25/7 to 25/9/1958+, 'Sunspot' 11/3/1959, Hurn mods 8/2/1960, 49 Sqdn 11/4/1960, Filton mods 8/3/1961, 49 Sqdn 10/4/1961, Marham 14/7/1961, Filton mods 30/4/1963, Marham 49 Sqdn 5/7/1963, Cat.3R RoS 71 MU 27/7/1964, Recat Cat.4R 26/9/1964. 8/12/1964 Disposal account Cat.5(c), 14/12/1964 SoC, 5/2/1965 Marham to Feltwell for NBS training allotted 7873M.

XD828 BK.1. f/f 18/12/1956, d/d 15/1/1957 Honington 7 Sqdn, MFS mods 20/12/1957 (6/Acft/14309), Honington 7 Sqdn 1/4/1958, white respray 30/7/1958, 'Grapple' 29/8/1958, MFS mods 28/10/1958, 7 Sqdn 11/12/1958, MFS mods 23/12/1959, 7 Sqdn 25/1/1960, 22/7/1960 7 Sqdn Wittering, Hurn 3/1/1961, Wittering 7 Sqdn 27/2/1961, Marham 207 Sqdn 24/7/1961, Hurn mods 16/2/1962, 207 Sqdn 19/4/1962, 32 MU 12/2/1964, 26/6/1964 2,577 flying hours, 6/1964 seen camouflaged. Disposal account 18/2/1965 Cat.5(c), SoC 5/3/1965.

XD829 BK.1. f/f 24/12/1956, d/d 15/1/1957 Wittering 49 Sqdn, 23/3/1957 Wisley RiW & conversion (6/Acft/15362), 10/5/1957 'Grapple', Wisley 23/7/1957, 49 Sqdn Wittering 22/11/1957, 25/4 to 29/8/1958+ 'Grapple', 49 Sqdn 9/1959, Hurn (Vickers) 24/9/1959 (Contract KK/G/082), 49 Sqdn 21/12/1059, Bristol 13/2/1961, 49 Sqdn 21/3/1961, Marham 49 Sqdn 14/7/1961, Hurn mods 11/12/1961, 49 Sqdn Marham 27/2/1962, BAC Filton 12/2/1964 (or 9/3/1964) mods and respray, 49 Sqdn Marham 20/3/1964, Airframe repair 26/6/1964 (2,252 flight hours). 23/3/1964 Marham Wing. Disposal account Cat.5(c) 18/2/1965, SoC 5/3/1965.

XD830 BK.1. f/f 2/1/1957, d/d 24/1/1957 Honington 7 Sqdn, NBS fitted 1/3/1957, MFS mods 21/4/1958 (6/Acft/14309), 7 Sqdn 16/7/1958, MFS mods 6/7/1959 (KK/G/080). 7 Sqdn 17/8/1959, Honington 90 Sqdn 19/7/1960, Filton mods 14/8/1961, 90 Sqdn 23/10/1961, Filton mods 26/2/1963, 90 Sqdn 18/4/1963, 7/7/1964 (2,700 hours). 26/9/1964 Disposal account Cat.4R, 15/12/1964 SoC Cat.5(c).

XD857 BK.1. f/f 5//1/1957, d/d 1/2/1957 Wittering 49 Sqdn, Wisley mods 26/7/1957 (6/Acft/15362) for survey after 'Grapple' – re-standardisation, 49 Sqdn Wittering 29/11/1957, 'Grapple' 25/4 to 2/5/1958+, 49 Sqdn, Hurn mods 8/6/1959, 49 Sqdn Wittering 26/8/1959, Filton mods 24/4/1961, 49 Sqdn 1/6/1961, Marham 49 Sqdn 14/7/1961, Filton mods 4/5/1962, 49 Sqdn 18/7/1962, Filton respray 6/2/1964, 49 Sqdn Marham 20/2/1964, 26/6/1964 AOG spares (2,518 hours), 6/1964 seen camouflaged. Disposal account Cat.5(c) 19/2/1965, 5/3/1965 SoC.

XD858 BK.1. f/f 15/1/1957, d/d 31/1/1957 Marham 214 Sqdn, 25/7/1957 Wittering 138 Sqdn, 22/10/1957 to USA, 8/11/1957 ret USA, 11/11/1957 207 Sqdn, 214 Sqdn 23/11/1957, 28/7 to 22/10/1958 'SAC Bombing Squadron', 23/10/1958 214 Sqdn, Malta 5/11 to 10/12/1958, MFS mods 22/12/1958 (6/Acft/14309), 214 Sqdn 23/2/1959, 27/5/1959 Special installations, Goose Bay 6/8/1959, 27/8/1959 V-A at Boscombe Down – Clearance trials, Mk.8 couplings and nozzles (KD/P/068/CB.6(a)), 9/1959 214 Sqdn, 'Sunspot' 11/8/1960, Hurn mods 21/5/1962, 214 Sqdn 17/7/1962, servicing 26/6/1964 (2,206 hours). Disposal account Cat.5(c) 18/2/1965, 4/3/1965 SoC.

XD859 BK.1. f/f 23/1/1957, d/d 14/2/1957 Marham 214 Sqdn, fit u/w tanks 1/5/1957, 25/5/1957 138 Sqdn, 25/9/1957 detached to SAC – ret. 8/11/1957, 148 Sqdn 12/11/1957, 214 Sqdn 1/12/1957, detached 'SAC Bombing Squadron' 28/7 to 15/10/1958, 214 Sqdn 23/10/1958, MFS mods 31/10/1958 (6/Acft/14309), 22/1/1959 214 Sqdn, Marham 31/1/1959, MFS 7/5/1959, 214 Sqdn 29/7/1959, Hurn mods 26/3/1962, 214 Sqdn 24/5/1962, BAC Filton Cat.4R repairs 20/20/1964, 10/6/1965 SoC Cat.5(c).

XD860 BK.1. f/f 30/1/1957, d/d 20/2/1957 Marham 214 Sqdn, fit u/w tanks 1/5/1957, 138 Sqdn 1/8/1957, det SAC (Pinecastle) 25/9 to 8/11/1957, 214 Sqdn 13/11/1957, 'SAC Bombing Squadron' 28/7 to 22/10/1958, 23/10/1958 214 Sqdn, MFS mods 29/10/1958 (6/Acft/14309), 214 Sqdn 5/1/1959 Marham, MFS 16/4/1959, 214 Sqdn 17/6/1959,

Filton mods 22/11/1962, 214 Sqdn 1/2/1963, 26/6/1964 (2,247 hours), 19 MU 3/12/1964. 18/2/1965 non-effective aircraft, 1/1/1967 Sold for scrap Bradbury & Co.

XD861 BK.1. f/f 4/2/1957, d/d 22/2/1957 Marham 214 Sqdn, u/w tanks fitted 1/5/1957, Wittering 138 Sqdn 10/5/1957, det SAC (Pinecastle) 13/9 to 8/11/1957, 214 Sqdn 12/11/1957, 'SAC Bombing Squadron' 28/7 to 22/10/1958, 23/10/1958 214 Sqdn, MFS mods 30/12/1958 (6/Acft/14309), 214 Sqdn 28/2/1959, Filton mods 27/8/1962, 214 Sqdn 25/11/1962, 26/6/1964 (2,171 hours). 18/2/1965 Disposal account Cat.5(c), 5/3/1965 SoC.

XD862 BK.1. f/f 15/2/1957, d/d Honington 90 Sqdn 1/3/1957, tyres burst on landing Kinloss 20/11/1957, 30/5/1958 Cat.3R FA – repaired, 9/1958 Farnborough Air Display, MFS mods 19/9/1958 (6/Acft/14309), 214 Sqdn 28/10/1958, Hurn mods 26/8/1959, 90 Sqdn 24/9/1959, Hurn mods 6/2/1961, Marham 148 Sqdn 13/3/1961, Filton mods 23/7/1962, 148 Sqdn 2/10/1962, Filton camouflage mods 9/7/1964, 148 Sqdn 24/7/1964 (2,774.5 hours & 1,179 landings). 18/2/1965 Disposal Account Cat.5(c), 5/3/1965 SoC.

XD863 BK.1. f/f 21/2/1957, d/d 13/3/1957 Honington 90 Sqdn, MFS 12/4/1958 (6/Acft/14309), 90 Sqdn 22/10/1958, MFS 4/3/1959, 7 Sqdn 11/4/1959, Hurn mods 9/6/1960, 7 Sqdn 8/7/1960, Filton mods 23/10/1961, 90 Sqdn 23/1/1962, Honington to Cambridge (MFS) 29/1/1962 for mod 3065 – 4,000 lb spares pannier (Contract KD/P/0124/CB.42(c)), 15/6/1962 Cambridge to Honington, 18/6/1962 90 Sqdn, BAC Filton repair 20/10/1964, 10/6/1965 SoC Cat.5(c).

XD864 BK.1. f/f 2/3/1957, d/d 19/3/1957 Honington 7 Sqdn, MFS mods 12/7/1957 (6/Acft/14309), 7 Sqdn 14/1/1958, MFS 2/1/1959, 7 Sqdn 25/3/1959, 'Sunspot' 6/8/1959, Hurn 11/4/1960, 7 Sqdn 3/5/1960, 25/7/1960 7 Sqdn Wittering, 12/8/1960 crashed at Spanhoe near Wittering after take-off; a/c took off but nose wheel failed to retract, pilot flew around trying to correct but a/c crashed due to lack of flying speed (Flt Lt B J Wickham, Flt Lt W R Howard, Flt Lt H G Bullen, Flt Lt A J Ireson, Sgt R H Johnson killed), Cat.5(s) FA. 13/8/1960 SOC.

XD865 BK.1. f/f 9/3/1957, d/d 22/3/1957 Honington 90 Sqdn, det Kano 3/5/1957, MFS 8/8/1958 (6/Acft/14309), 90 Sqdn 23/9/1958, Hurn 17/11/1959, 90 Sqdn 21/12/1959, Hurn 14/3/1961, 90 Sqdn 18/4/1961, 1/6/1961 207 Sqdn, Marham 207 Sqdn 14/7/1961, Filton 6/3/1963, 207 Sqdn 30/4/1963, 26/6/1964 (2,835 hours). 18/2/1965 Disposal account Cat.5(c), SoC 5/3/1965.

XD866 BK.1. f/f 22/3/1957, d/d 29/4/1957 Wittering 138 Sqdn, A&AEE 5/6/1957, Wittering 26/6/1957, 'Profiteer' 1/7/1958, MFS 8/8/1958 (6/Acft/14309), Wittering 138 Sqdn 22/9/1958, MFS 13/3/1959, 138 Sqdn 24/4/1959, Hurn mods 22/9/1959 (KK/G/080), 138 Sqdn 20/10/1959, Wyton CWP 15/5/1962, Gaydon 232 OCU 13/7/1962 (or 5/6/1962), Filton mods 4/3/1963, 232 OCU 15/5/1963, 90 Sqdn 30/6/1964 (2,119 hours). Disposal account Cat.5(c) 18/2/1965, SoC 4/3/1965.

XD867 BK.1. f/f 2/4/1957, d/d 18/4/1957 Honington 90 Sqdn, MFS 1/4/1958 (6/Acft/14309), 90 Sqdn 10/7/1958, MFS 23/7/1959 Cat.4 M/S (KK/G/052), 90 Sqdn 5/1/1960, Filton mods 28/8/1961, 90 Sqdn 9/11/1961, Filton 8/4/1963, 90 Sqdn 26/6/1963, 7/7/1964 (2,363 hours). Disposal account Cat.5(c) 18/2/1965, SoC 1/3/1965. To Honington for fire-fighting training.

XD868 BK.1. f/f 15/4/1957, d/d 10/5/1957 Wittering 138 Sqdn, Canada 16/8 to 30/8/1957, Nairobi 24/9 to 11/10/1957, USA 18/10 to 25/10/1957, MFS mods 22/5/1958 (6/Acft/14309), 138 Sqdn 25/7/1958, detached 'Sunspot' 9/1 to 6/2/1959, 'Profiteer' 1/7/1959, MFS mods 30/7/1959, 138 Sqdn 1/9/1959, Wyton 16/4/1962, BCDU Finningley 25/4/1962, Finningley OCU 2/3/1964, Filton 3/9/1964 for camouflage, Gaydon 232 OCU 23/10/1964 (2,232.5 hours). Disposal account Cat.5(c) 18/2/1965, SoC 4/3/1965.

XD869 BK.1. f/f 2/5/1957, d/d 28/5/1957 Marham 214 Sqdn, tanker conversion 12/2/1958, MFS 26/6/1958, 214 Sqdn Marham 27/8/1958, Malta 5/11 to 26/11/1958+, 11/9/1959 crashed on take-off 2.7 miles from end of Marham runway and caught fire (tailplane incidence reversal?) Cat.5(s) (crew Flt Lt T C Watkins, Flg Off P E Wormall, Flt Lt D Howard, Flt Lt M F Hyslop, Flg Off C Candy, C/T R V Sewell). 16/9/1959 SoC.

XD870 BK.1. f/f 10/5/1957, d/d 23/5/1957 Marham 214 Sqdn, tanker conversion 19/2/1958, 2/6/1958 148 Sqdn, MFS 15/7/1958 (6/Acft/14309), Marham 148 Sqdn 15/9/1958, 214 Sqdn 22/12/1958, det Kano 17/6 to 15/7/1959, MFS mods 15/2/1960, 214 Sqdn 31/3/1960, Filton for camouflage & mods 1/3/1963, 214 Sqdn 8/5/1963, 26/6/1964 (2,161 hours). Disposal account Cat.5(c) 18/2/1965, SoC 4/3/1965.

XD871 BK.1. f/f 7/6/1957, d/d 27/6/1957 Honington 90 Sqdn, MFS 1/4/1958 (6/Acft/14309), Honington 90 Sqdn 24/6/1958, MFS mods 9/6/1959 (KK/G/080), Vickers 9/7/1959 for M/S (KK/G/082), 90 Sqdn 2/11/1959, Wittering 7 Sqdn 15/12/1961 (or 1/1/1962), Filton mods 15/1/1962, 138 Sqdn 27/4/1962, 214 Sqdn 3/5/1962, NBS fitted at Marham 12/5/1962, 26/6/1964 (2,437 hours). Disposal account Cat.5(c) 18/2/1965, SoC 4/3/1965.

XD872 BK.1. f/f 18/6/1957, 28/6/1957 handed over for tropical trials (6/Acft/14047/CB.6(a)), 5/7/1957 Sprite torn off in flight – Cat.2 damage, 8/7/1957 Weybridge to Boscombe Down – A&AEE tropical trials in N Africa, Idris 10/7/1959, A&AEE 18/8/1957, 18/9/1957 Boscombe to Wisley for removal of instrumentation, 4/10/1957 to A&AEE for maximum take-off weight flight trials, Wisley 24/10/1957, Wittering 138 Sqdn 13/1/1958, 'Sunspot' 11/4/1958, Wisley 7/7/1958, A&AEE trials 25/7/1958, Wisley 19/8/1958, A&AEE 28/8/1958, Wisley 9/9/1958, Wittering 138 Sqdn 1958, 'Sunspot' 9/1 to 16/1/1959, MFS 23/1/1959 (6/Acft/14309), 138 Sqdn 12/3/1959, 1/6/1959 BCDU Wittering, 1/3/1960 BCDU Finningley, Hurn mods 19/9/1960, BCDU 21/11/1960, Wittering 7 Sqdn 25/8/1961, Filton 25/9/1961, Honington 90 Sqdn 19/12/1961, BAC Filton 19/10/1964, SoC 10/6/1965.

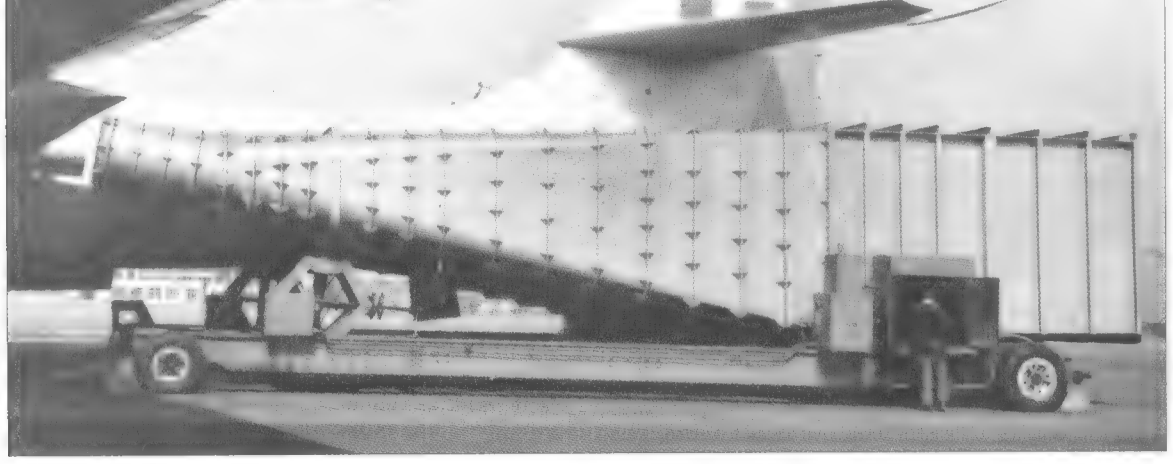
XD873 BK.1. f/f 4/7/1957. d/d 22/7/1957 Marham 207 Sqdn, 49 Sqdn 19/10/1957, 1/11/1957 'Grapple', 207 Sqdn Marham 13/11/1957, det Malaya 11/6 to 25/6/1958, det 'SAC Bombing Squadron' 28/7 to 15/10/1958+, 207 Sqdn 23/10/1958, MFS 23/2/1959, Marham 207 Sqdn 18/4/1959, Hurn mods 27/6/1960, 207 Sqdn 25/7/1960, Wittering 138 Sqdn 30/5/1961, Wittering 7 Sqdn 1/5/1962, Filton mods 25/6/1962, 7 Sqdn 28/8/1962, Gaydon 232 OCU 25/4/1963 (or 23/10/1962), 30/6/1964 (2,536 hours). Disposal account Cat.5(c) 18/2/1965, SoC 4/3/1965.

XD874 BK.1. f/f 23/7/1957, d/d 30/8/1957 Marham 214 Sqdn, 16/10/1957 49 Sqdn, 'Grapple' 25/10 to 12/1957, 1/12/1957 214 Sqdn, 16/12/1957 138 Sqdn, det 'SAC Bombing Squadron' 28/7 to 22/10/1958, 23/10/1958 148 Sqdn, MFS 3/11/1958 (6/Acft/14309), Marham 148 Sqdn 24/12/1958, det Butterworth 4/2 to 25/2/1959+, 148 Sqdn, MFS 18/9/1959 Cat.4 M/S (KK/G/052), 148 Sqdn 12/1/1960, Hurn mods 2/1/1961, 148 Sqdn 15/2/1961, Filton mods 15/2/1963, 148 Sqdn 19/4/1963, 26/6/1964 (2,371 hours), 25/9/1964 Marham Wing. 18/2/1965 Disposal account Cat.5(c), 5/3/1965 SoC.

XD875 BK.1. f/f 27/8/1957, d/d 24/9/1957 207 Sqdn, Farnborough SBAC Show 30/8/1957, Wisley 9/9/1957, Marham 49 Sqdn 24/9/1957, SAC 10/9/1958, 49 Sqdn 11/10/1957, 207 Sqdn 13/11/1957, 28/7/1958 'SAC Bombing Squadron', 23/10/1958 207 Sqdn, MFS 18/12/1958 (6/Acft/14309), Marham 207 Sqdn 9/2/1959, MFS mods 15/3/1960, 207 Sqdn 16/4/1960, Wittering 138 Sqdn 26/7/1961, 7 Sqdn 16/4/1962 (or 1/5/1962). Aircraft Cat.5(c) 5/11/1962, SoC 9/11/1962.

Total Built 104 (107 with two prototypes plus one B Mk.2)

6 Valiant BK Mk.1, XE294 to XE299, reported as an order under continued procurement contract No 6/Air/9446/CB.6(c). Serials allotted 18/5/53 but order later cancelled.



During their careers, many Valiants returned to Wisley for maintenance and or repair. A massive pair of silencers were built specially for Valiant engine ground running at Wisley to meet the wishes of the Royal Horticultural Society whose famous gardens are nearby. Tony Buttler collection

Bristol Pegasus Test-Bed

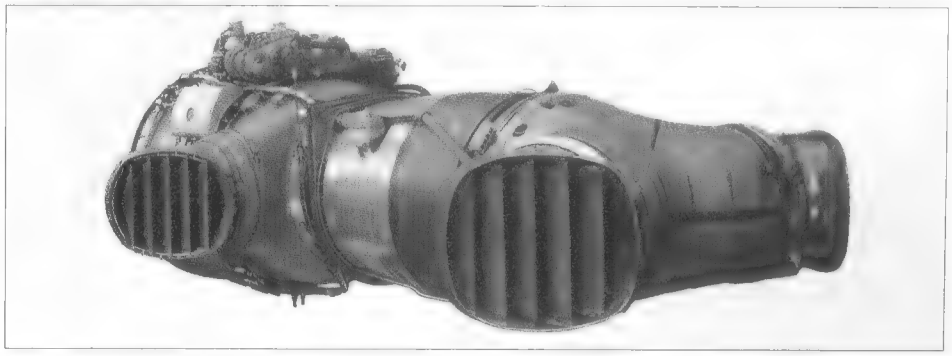
Above: **WP199 flying with the Pegasus in position.**

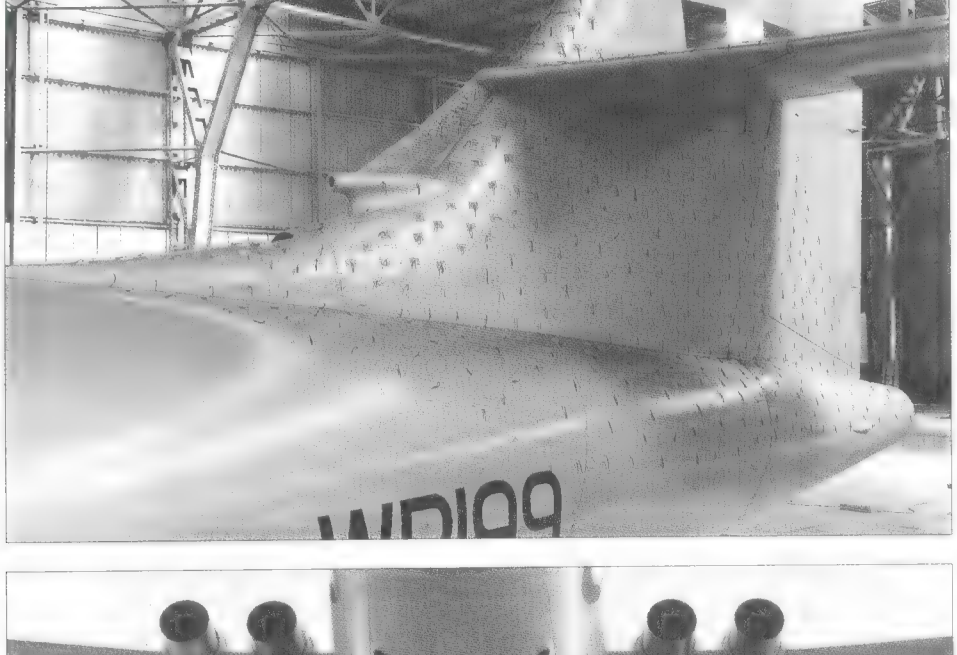
Below: **Bristol-Siddeley Pegasus engine.**

WP199 was the first production Valiant and first flew on 21st December 1953. On 20th August 1954 it was forced to make an emergency diversion to A&AEE Boscombe Down (where it was repaired) before going to A&AEE officially on 18th December as a trials aircraft. There it was used for airflow investigation and radar clearance. Nearly five years later, on 11th September 1959, it flew to Martin-Baker for ejection seat research (Chapter 5) and then went to Marshalls of Cambridge on 1st July 1960 for major servicing. Afterwards, on 3rd January 1961, it was flown to Bristol Siddeley for trials with the BE.53 Pegasus vectored thrust vertical take-off turbofan.

The BE.53 first ran in August 1959 and tethered hovering by the prototype Hawker P.1127 XP831 commenced on 21st October 1960. On 19th March 1961 the aircraft made its first conventional flight and during September completed the first two-way transitions between hovering and wingborne flight. The thrust of these early engines was 10,400 lb (46.2kN) but this figure was increased to 18,400 lb (81.8kN) during flight development. It was intended to use WP199 as a flying test-bed to help develop this new and revolutionary engine by fitting an example in the bomb bay.

It took time to convert WP199 to take the 13,500 lb (60.0kN) Pegasus 3 but Tom Frost finally got it into the air on 11th March 1963. However on the third flight, before much data had been obtained, the belly installation began to disintegrate. This was witnessed by the chase plane, a Jet Provost flown by Flt Lt Prithee Singh of the Indian Air Force. Up to this point Singh had been reporting in English but when he saw what was happening he reverted to his native tongue, which of course was not understood by the Valiant crew. The nacelle that covered the Pegasus intake had peeled back and this caused other damage which forced a three-month lapse in the test programme. The delay was further complicated when 'foreign object debris', left behind by servicing crews, was sucked into the Pegasus during ground running, which did the engine no good at all. In the end, thanks to a variety of problems, only 50 of the planned 70 Valiant/Pegasus test flights were completed. By 17th September 1964 WP199's total flying time had reached just 320 hours 40 minutes.





Top: **Airflow investigations; wool tufts fitted to WP199 for flow checks at the fin junction.**

Left and below: **Close-up views of the Valiant with the Pegasus engine installation.**

Civil Developments

Vickers V.C.5

In February 1950, a long time before the first Valiant had flown, Vickers commenced work on the V.C.5 (Vickers Commercial) high-speed airliner. This would be powered by four jet engines and was to provide spacious, pressurised accommodation for 40 or 50 passengers over distances up to 3,000nm (5,556km). It was designed to operate on a direct route from London to New York, covering the journey in approximately eight hours and thereby reducing the current time by more than 50%. Design cruising speed would be in the neighbourhood of 465 knots (862km/h) and operating altitude in the region of 46,000ft (14,021m). The 3,000nm range made the aircraft extremely attractive for the London to Sydney and Sydney to San Francisco or New York routes.

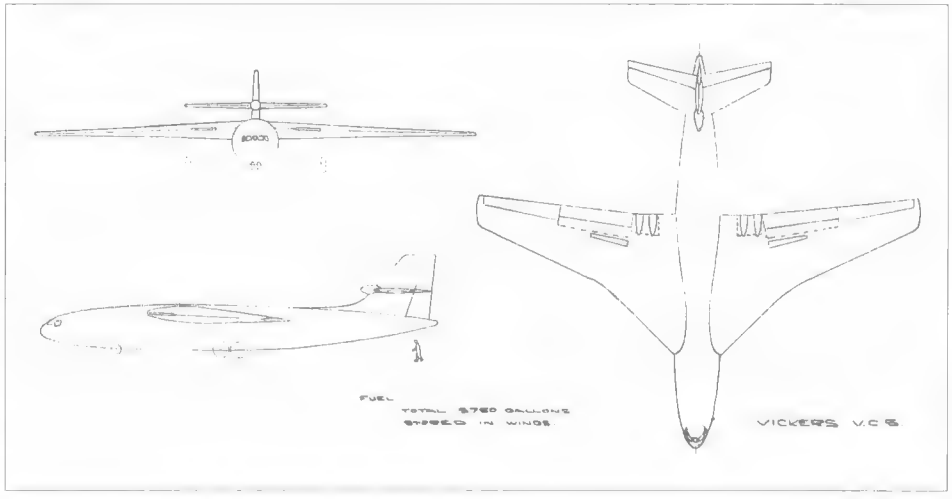
V.C.5 would basically be a conversion of the Type 660 Valiant, the object being to utilise, as far as possible, components that had been tried and tested, thereby reducing to a minimum the required design and manufacturing time. Passenger accommodation would be arranged on one floor level and the seats would be fitted in ten rows of five with the rows arranged completely forward of the jet pipes to eliminate noise. The seats selected by Vickers were of the sleeperette type, pitched at 50in (127cm) about a gangway of 20in (51cm), and each passenger would be allowed 70 lb (32kg) of luggage of which 60 lb (27kg) would be stored in luggage holds provided fore and aft while the remaining 10 lb (5kg) could be hand luggage carried in the cabin.

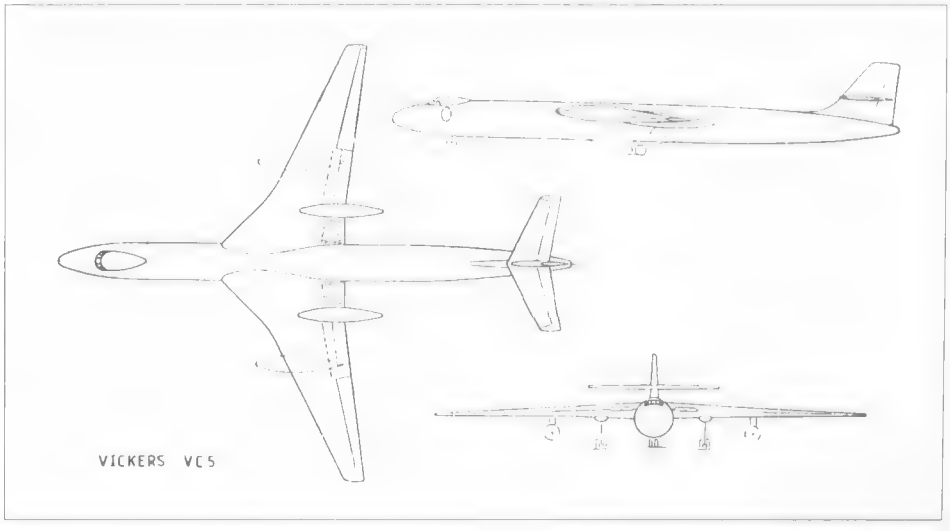
Toilet compartments would be provided aft of the saloon and a pantry was placed at the forward end of the aircraft opposite the crews' entrance door, thus enabling easy access for provisioning. Two freight holds would be provided, one at each end of the saloon, each with a capacity of approximately 350ft³ (9.91m³). The planned 3,000nm range would include enough fuel to accommodate a 50 knot (93km/h) headwind between London and New York (or a 70 knot [130km/h] headwind when flying London-Gander-New York), a 200nm (371km) diversion, a 5% navigation error and a 45-minute stand-off before landing.

The following performance was predicted for London-New York or London-Gander-New York using three alternative engine types.

Vickers made many studies into the expected utilisation of the V.C.5 including an annual workload for up to half a dozen aircraft. Throughout the firm estimated a load factor of between 50% and 100% and in one scheme the aircraft was being flown for 15.12 hours per day with total flying hours per year reaching 11,000. Vickers estimated that each aircraft would fly

Engine	Conway	Avon	Sapphire
Distance, nm (km)	3,000 (5,559)	3,000 (5,559)	3,000 (5,559)
All-up-weight, lb (kg)	131,400 (59,603)	122,000 (55,339)	122,000
Fuel, gallons (litres)	5,760 (26,190)	5,870 (26,690)	5,700 (25,917)
Mean cruise speed, kts (km/h)	469 (869)	400 (741)	435 (806)
Max. cruise speed, kts (km/h)	492 (912)	467 (865)	476 (882)
Altitude, ft (m)	47,500 (14,478)	41,500 (12,649)	44,500 (13,564)
Take-off distance, yds (m)	1,400 (1,280)	2,100 (1,920)	1,700 (1,554)
Block time – westbound, hrs	8.1	9.3	8.51
Block time – eastbound, hrs	6.55	7.55	7.02





Top right: **Vickers V.C.5 (drawing dated 2nd February 1950). This was Vickers' answer to the de Havilland DH.106 Comet which first flew on 27th July 1949 with four 4,450 lb (19.8kN) de Havilland Ghost 50 engines and seating for 36 passengers.**

Right: **Another design drawn in 1951 was a long-range V.C.5 with a more pencil-like fuselage shape and underwing fuel tanks. The main undercarriage retracted into 'speed pods' to make more room for fuel in the wings.**

Left: **Model of the Vickers Type 1000.**

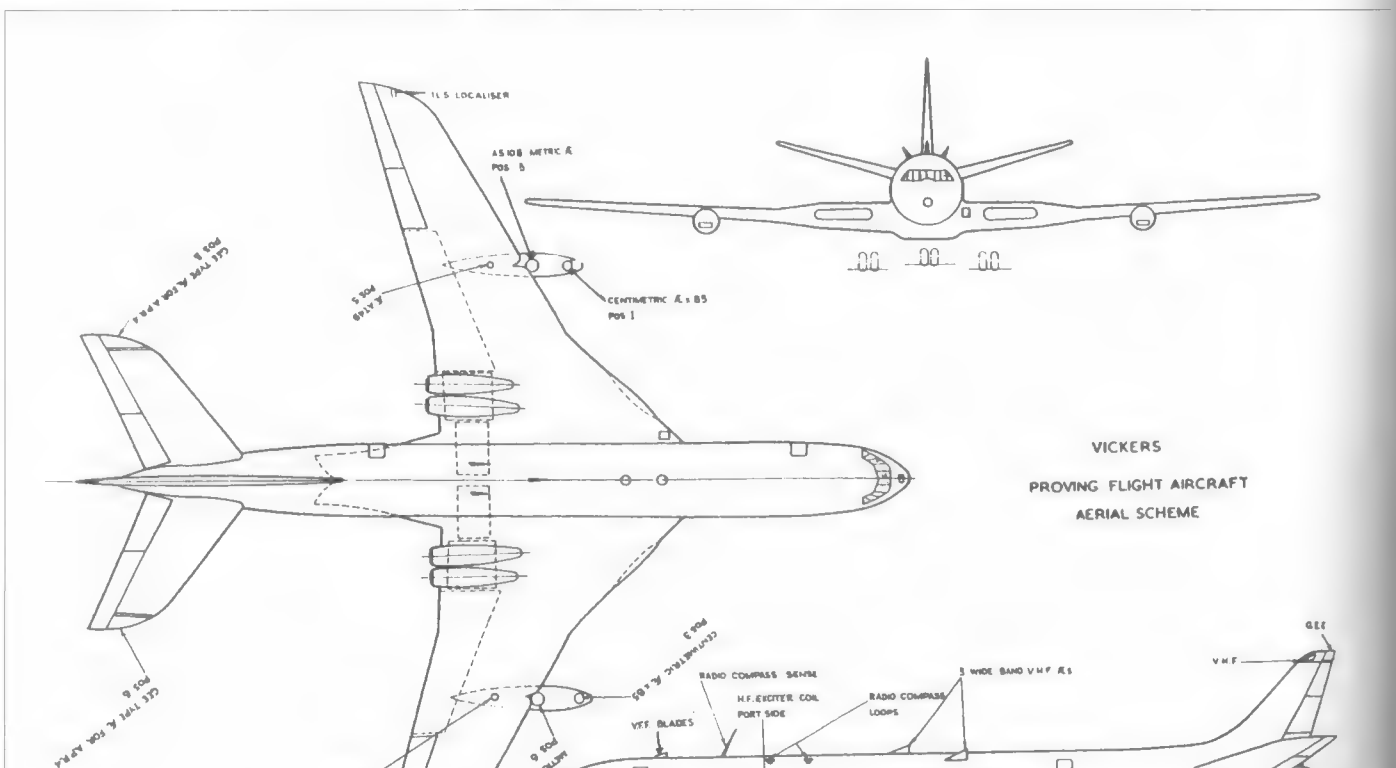
Below: **How the proving flight aircraft XD662 would have appeared with various test aerials, underwing pods and other attachments in place.**

for 458 hours, then have a ten-day check, fly another 458 hours then receive a 20-day overhaul, and this would give an annual figure of 245 days flying plus 120 on the ground for servicing.

This project eventually became the Vickers Type 1000 and a prototype, XD662, was ordered by the Air Ministry to Specification C.132D and Operational Requirement OR.325 on 2nd October 1952 under contract 6/Air/8630/CB.6(c). The Ministry noted that 'The Royal Air Force requires a fast long-range jet transport capable of carrying large loads of men and equipment quickly to any part of the world. The aircraft will also be wanted for radio counter measures and must carry 120 passengers at 180 lb (87kg) each plus 70 lb (32kg) baggage each, or 30,000 lb (13,608kg) freight, over a distance of 2,100nm (3,891km) at 450 knots (834km/h) TAS at 40,000ft (12,192m). For a range of 3,000nm the payload must be greater than 10,000 lb (4,536kg).' Six more, XH255 to XH260, were ordered for the RAF in September 1955 as high-speed transports.

Vickers V.C.6

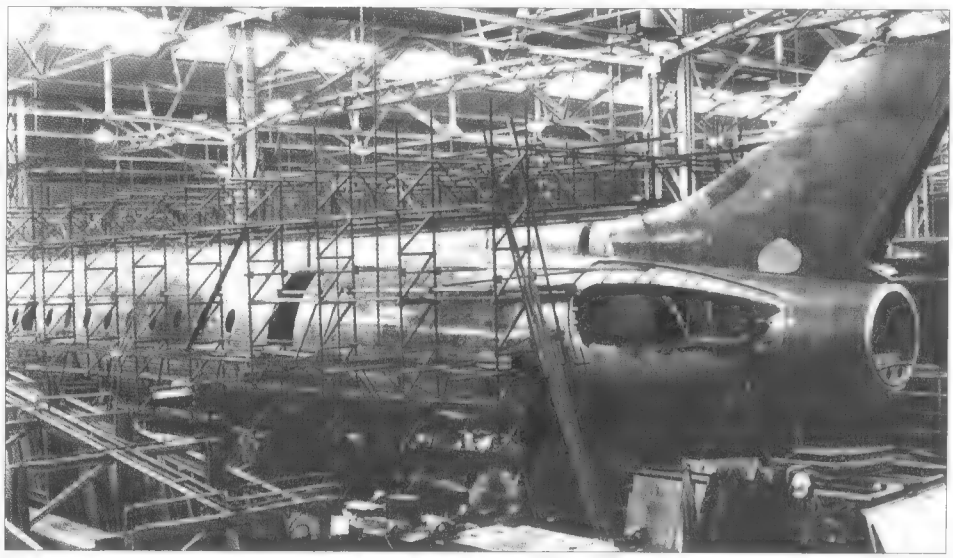
The V.C.6 was a similar design to the V.C.5 but described a short-range feeder airliner specifically prepared in 1952 for British Overseas Airways Corporation (BOAC – today part of British Airways). Later, an RAF version would have been the Vickers Type 1001; Type 1002 was allocated to the BOAC aircraft and Type 1003 for other airlines including Pan American and TCA who were showing interest. The V.C.6's powerplants were to be 15,150 lb (67.3kN) Rolls-Royce Conway R.Co.5s and the aircraft would have flown the London-New York route with at least 20% fuel reserves.



Vickers V.C.7

This was the swan song of the Valiant type and was basically a developed 1001/1003 series fitted with uprated Conway R.Co.5s of 14,500 lb (64.4kN) thrust to give the aircraft an increased cruising speed of 518mph (833km) at 40,000ft (12,192m); by mid-1954 Rolls-Royce was offering the further uprated Conway R.Co.6 which would deliver 15,000 lb (66.7kN) at take-off. In August 1954 C H Jackson of BOAC's Operations Development Unit wrote to George Edwards to explain that he had worked out that a thrust of 16,400 lb (72.9kN) was required to meet tropical conditions at an aircraft all-up-weight of 215,000 lb (97,524kg). Edwards replied that boundary layer control or reheat (plus water methanol if necessary) would give the required extra power. By September 1955 the Conway 5 was giving 16,600 lb (73.8kN) with reheat and water methanol and all-up-weight had reached 220,000 lb (99,792kg).

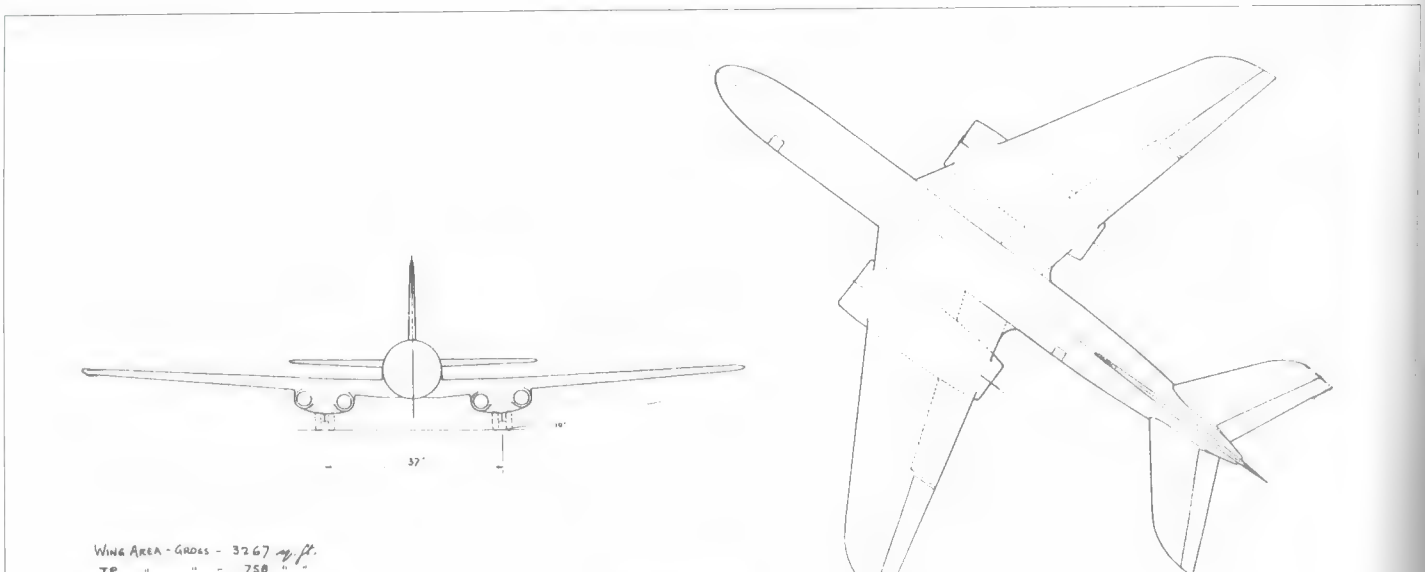
A good deal of work went into this project which eventually embraced seven schemes numbered V.C.7A to V.C.7G, the original shape of the Valiant being changed so that various other aspects of airliner design could be stud-

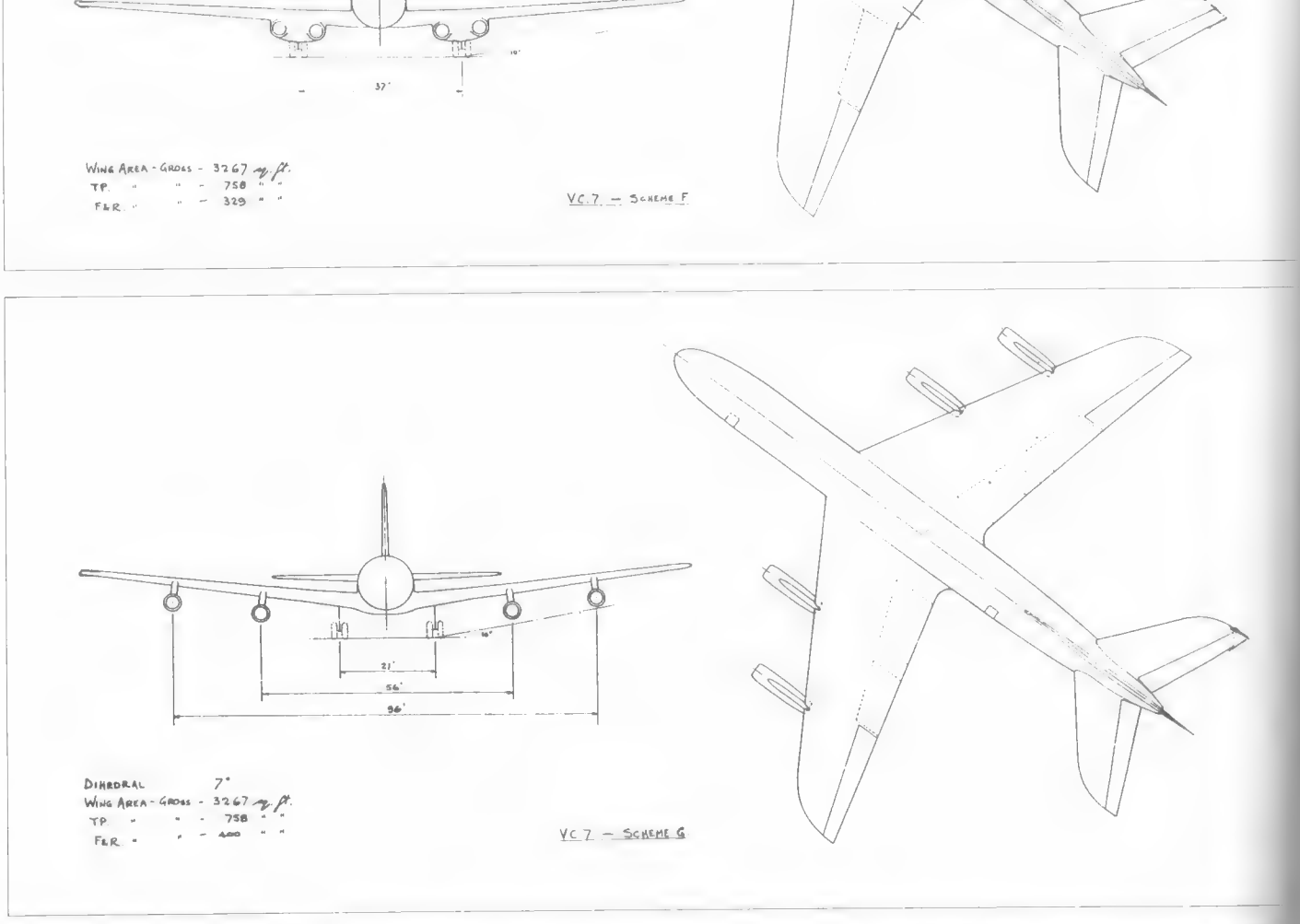


Top: **View of XD662's fuselage when about 80% complete.** Phil Butler collection

Centre: **The V.1000's fuselage during construction surrounded by scaffolding.**

Bottom: **XD662 fuselage and wing inner section remains at Wisley in 1957.** J Threadgold collection





ied. On 18th November 1955 Vickers completed a table showing six different versions of the V.C.7 Type 1003 for the London-New York route which revealed just how the development of the Conway had progressed from the 11,500 lb (51.1kN) thrust level of February 1953 to the 21,000 lb (93.3kN) figure for the Super Conway (as it was called) of 1955.

1. Developed Conway 18,700 lb (83.1kN) wet, all-up-weight 260,000 lb (117,936kg);
2. Super Conway 17,000 lb (75.6kN) dry, all-up-weight 262,000 lb (118,843kg);
3. Super Conway 21,000 lb (93.3kN) wet, all-up-weight 264,000 lb (119,750kg);
4. As 1 plus integral fuel tanks, all-up-weight 247,000 lb (112,039kg);
5. As 2 plus integral fuel tanks, all-up-weight 249,000 lb (112,946kg);
6. As 3 plus integral fuel tanks, all-up-weight 251,000 lb (113,854kg).

These integral tanks would save at least 5,000 lb (2,268kg) on the aircraft's basic operational weight.

V.C.7 Scheme G showed an aircraft with a wing area of 3,267ft² (303.8m²), 7° of dihedral and a layout similar to the Boeing 707 which had a wing area of 2,433ft² (226.3m²) and was powered by four 12,500 lb (55.6kN) engines. The 707 had the support of a well-funded budget whereas in the United Kingdom the Government was always penny pinching and seems to have had no foresight whatsoever. In late 1955 the Air Staff was told to cut its costs and since the V.1000 was one of the costliest programmes, it had to go. The V.1000 contracts were cancelled on 29th November 1955 and the Bristol Britannia was ordered for the RAF (BOAC having ordered some examples back in 1949); also with the cancellation of the Supermarine Swift and the abandonment of the de Havilland Comet 2, there was a desire to give some work to Short Brothers in Belfast.

The UK Government had not wished to go alone on the V.1000 and wanted BOAC to buy some, but the airline was not interested and turned a blind eye to it; BOAC had the Britannia and would not support the V.1000 project as the lead customer. Eventually the British airline bought American jet airliners instead and, after it had opted out, TCA and Pan Am then ended their interest in the V.1000 and another major British project ended up on the scrap heap. By this time the prototype was nearing completion but it made no difference; the order was given to cut it into 20ft (61m) lengths for use at Shoeburyness.

Long-Range Bomber Development

In August 1949 Vickers completed three schemes for a Long-Range Bomber based on the Valiant (but separate to the long-range project described in Chapter 1). Prior to the release of the original B.35/46 specification for a medium bomber, the RAF had been particularly keen to have a long-range bomber with a still-air range of 5,000nm (9,265km) and an over target speed of 500 knots (927km/h) at a height of 50,000ft (15,240m). Alternative bomb loads would be one 10,000 lb (4,536kg) special, one 10,000 lb HC, two 5,000 lb (2,268kg) HC, 15 1,000 lb (454kg) MC or LC, or 15 1,000 lb clusters. The desire for this type persisted for several years and one result was this group of studies by Vickers.

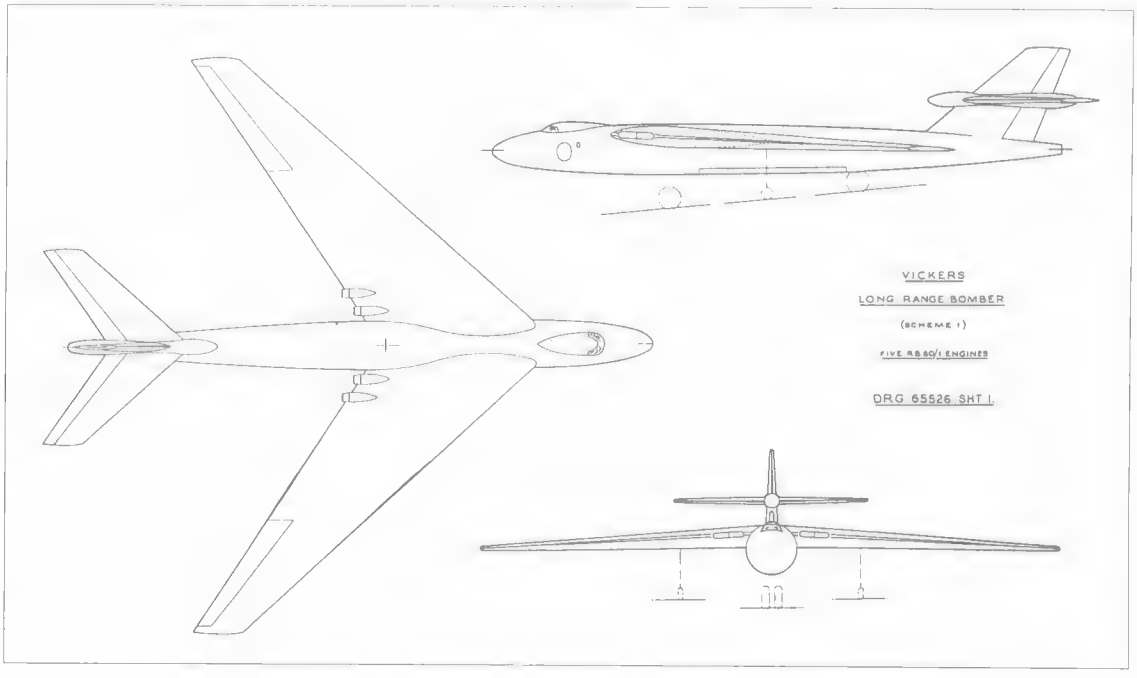
The basis of Scheme 1 was a development of the Vickers B.9/48 (Valiant) in which as much as possible of the background and knowledge that was acquired in building that aeroplane was employed in the new one. The principal changes were the maintenance of a continuous sweepback of 45°. instead of the B.9/48's 'crank' planform and a longer fuselage made necessary by this, a new bicycle undercarriage because the thin wing would no longer house a conventional undercarriage and five 9,700 lb (43.1kN) Rolls-Royce RB.80/1 engines (later called Conway) of which four were built into the wing roots and one in the tail of the fuselage. This aeroplane, which was described by Vickers as 'fairly representative of the British approach' would cruise over the target at 500 knots and 49,000ft (14,935m).

The estimated data showed that Scheme 1 had a span of 128ft 0in (39.0m), length 134ft 8in (41.0m), gross wing area 3,200ft² (297.6m²), t:c ratio root 12% and tip 8%, tare weight 81,945 lb (37,170kg), total take-off weight 163,600 lb (74,209kg), full load service ceiling 49,800ft (15,179m) and it could take off at full load in 1,400 yards (1,280m); a landing at full load less bomb and half fuel would be made in 850 yards (777m). All three schemes possessed a 5,000nm (9,265km) range with a 10,000 lb bomb and needed 8,375gals (38,080 lit), 8,674gals (39,440 lit) and 8,292gals (37,703 lit) respectively to meet this limit. Scheme 1's maximum speed at a mean weight of 123,560 lb (56,047kg) was 537 knots (995km/h) at sea level, 546 knots (1,012km/h) at 30,000ft (9,144m) and 520 knots (964km/h) at 50,000ft (15,240m). Full load rate-of-climb was 4,680ft/min (1,426m/min) at sea level, 2,450ft/min (747m/min) at 30,000ft and 1,350ft/min (411m/min) at 40,000ft. At the end of the 5,000nm sortie, Scheme 1 would be flying at 54,000ft (16,459m).

After a close examination of current American bomber projects Vickers also felt it would be well worthwhile to do two alternative approaches based on the American conception of higher wing loadings and aspect ratios. In accordance with British practice, Scheme 1 had an aspect ratio of 5.12 and a take-off wing loading of 51.1 lb/ft² (249.5kg/m²) while Schemes 2 and 3 were each prepared with wing loadings and aspect ratios progressively in excess of Scheme 1. Both of these additional projects had their engines housed in external nacelles since there was insufficient absolute depth to place them in the wing.

Aspect ratio for Schemes 2 and 3 was 6.82 and 8.58 respectively, wing area 2,405ft² and 1,910ft² (223.7m² and 177.6m²), total take-off weight 165,500 lb and 167,150 lb (75,071kg and 75,819kg), take-off wing loading 68.8 and 87.5 lb/ft² (335.9 and 427.2kg/m²), over target cruise speed 492 knots (912km/h) at 49,800ft (15,179m) and 504 knots (934km/h) at 50,000ft (15,240m), and full load service ceiling 48,800ft (14,874m) and 49,000ft (14,935m) respectively. Using 10,000 lb (44.4kN) of rocket thrust Scheme 2 could get off at full load in 1,575 yards (1,440m) while Scheme 3, with 20,000 lb (88.9kN) rocket assistance, needed 1,500 yards (1,372m); equivalent landing distances at full load less bomb and half fuel were 1,100 yards (1,006m) and 1,450 yards (1,326m).

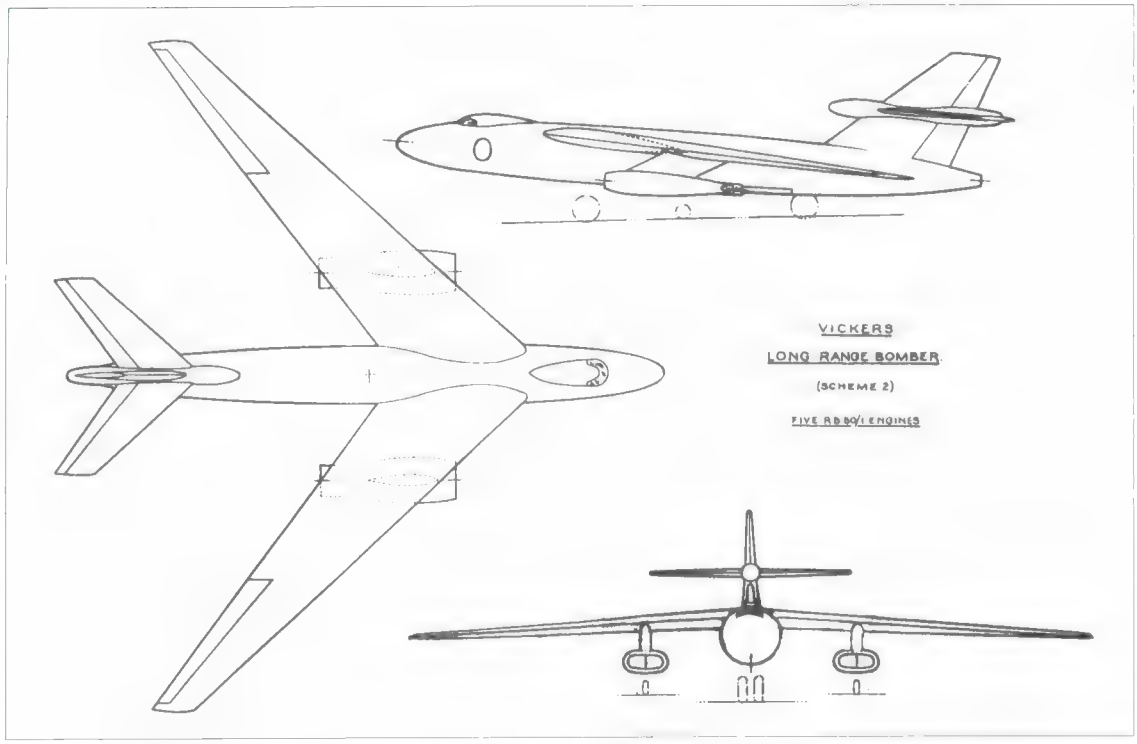
Scheme 2's span was 128ft 0in (39.0m), length 116ft 0in (35.4m), t:c ratio 12% to 10% and tare weight 79,425 lb (36,027kg). Maximum speed at a mean weight of 121,350 lb (55,044kg) was 541 knots (1,002km/h) at sea level, 545 knots (1,010km/h) at 30,000ft and 520 knots (964km/h) at 50,000ft. Full load rate-



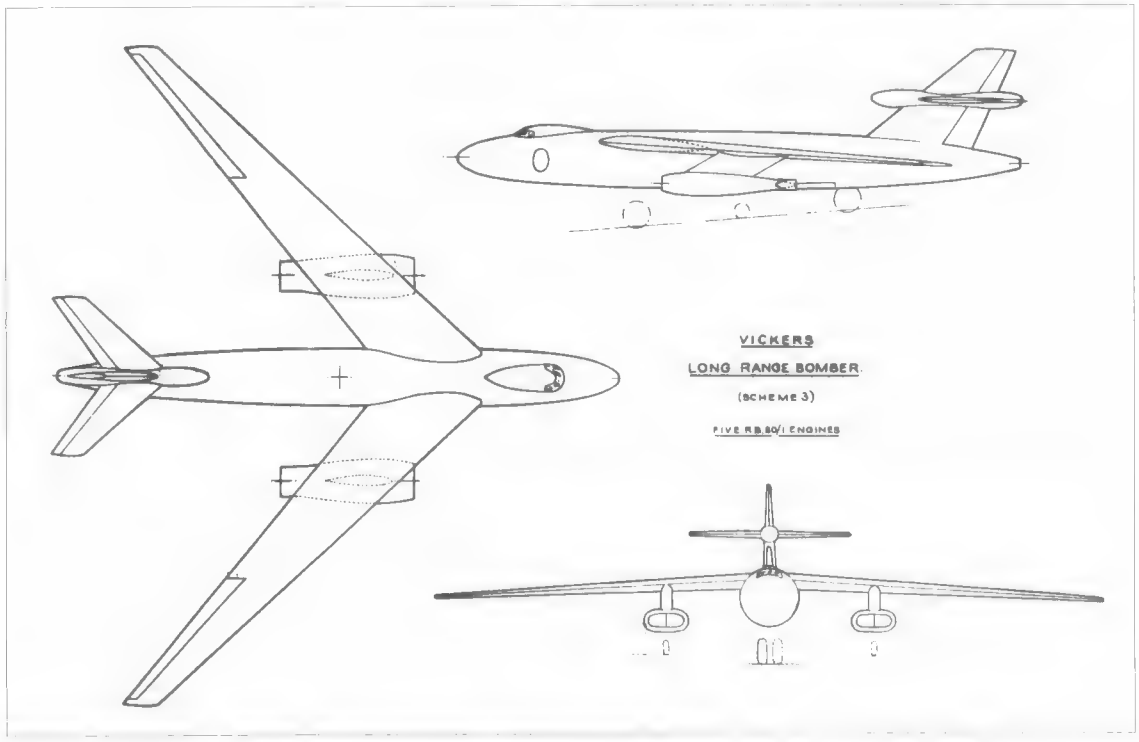
Right: **Vickers Long-Range Bomber Scheme 1**

Opposite page, top: **V.C.7 Scheme F of September 1955 with engines combined into single nacelles and wing area 3,267ft² (303.8m²) (Valiant's wing area was 3,362ft² [219.7m²]).**

Opposite page, bottom: **Vickers V.C.7 Scheme G.**



Vickers Long-Range Bomber Scheme 2 (Drawing 65527 sheet 1).



Vickers Long-Range Bomber Scheme 3 (65528 sheet 1) was similar to Scheme 2 bar having a wing of narrower chord.

of-climb was 4,670ft/min (1,423m/min) at sea level, 2,400ft/min (732m/min) at 30,000ft and 1,350ft/min (411m/min) at 40,000ft. At the end of the 5,000nm sortie, Scheme 2 would reach an altitude of 53,000ft (16,154m).

Scheme 3's span was 128ft 0in, length 109ft 6in (33.4m), t:c ratio 12% to 10% and tare weight 82,165 lb (37,270kg). Maximum speed at a mean weight of 123,860 lb (56,183kg) was 568 knots (1,053km/h) at sea level, 549 knots (1,017km/h) at 30,000ft and 530 knots (982km/h) at 50,000ft. Full load rate-of-climb was 5,000ft/min (1,524m/min) at sea level, 2,580ft/min (786m/min) at 30,000ft and 1,370ft/min (418m/min) at 40,000ft. At the end of the 5,000nm sortie, Scheme 2 would have reached an altitude of 54,000ft (16,459m).

In general the following conclusions were drawn:

1. Scheme 2 produced the lightest wing (24,000 lb [10,886kg] against 27,000 lb [12,247kg] for 1 and 28,000 lb [12,701kg] for 3)
2. Rocket assisted take-off was essential for Schemes 2 and 3 and both showed high take-off and landing speeds
3. Schemes 2 and 3 had a poor margin of excess *g* for manoeuvre and their external engine nacelles brought with them an increase in profile drag of 15% for the former and 17% for Scheme 3 (in this respect Vickers noted that the American XB-47 bomber's nacelles were certainly much worse than the wings).

It seemed therefore that, on balance, Scheme 1 was the best solution, particularly bearing in mind the British limitation on aerodromes and the fact that the design would manoeuvre at a minimum of 2 *g*.

Preparing Valiant for the New Zealand Air Race

By 9th December 1952 details of the Royal Air Force entry into the New Zealand Air Race using the prototype Valiant were well known within the RAF and on that date Wg Cdr D P Davies visited Weybridge to discuss with Vickers personnel and Bomber Command's Flt Lt Collins the work needed to prepare for the race (which, as the following shows, was a considerable effort). Possible routes suggested by Mr Wright of Vickers were:

1. Primary Plan: England-Basrah-Cocos Islands-Christchurch which would require a take-off weight of 160,000 lb (72,576kg) and the use of RATOG or
2. Secondary Plan: England-Basrah-Negombo-Darwin-Christchurch which did not require external tanks or take-off assistance because maximum take-off weight would only be 130,000 lb (58,968kg). The meeting did not agree with the Air Ministry who had suggested London-Basrah-Singapore-Christchurch.

Doubt was expressed as to whether the prototype Valiant could accept the heavier fuel load of production machines; the probable fuel load was estimated to be 10,870gals (49,425 lit) with 3,630gals (16,505 lit) in two main fuselage tanks, 2,060gals (9,367 lit) in two main wing tanks, 3,300gals (15,005 lit) in two drop tanks and 1,880gals (8,548 lit) in an additional bomb bay tank. It was clear that RATOG and water methanol would be necessary at take-off, RATOG for the aircraft's loaded condition and water methanol to retain engine performance in tropical conditions. The Armstrong Siddeley Scarab rockets would give a thrust of 8,000 lb (35.6kN) for a duration of 40 to 60 seconds and were considered an essential installation for airfields with less than 2,000 yards (1,829m) of runway.

On 16th April 1953 the Air Ministry confirmed to Vickers that the Air Council had entered the second prototype, WB215, for the speed section of the Air Race from England to Christchurch and the route would be via Karachi and Djakarta (Java). Additional navigational aids would be fitted along with improved crew comfort facilities. The aircraft would be operated by Bomber Command with a crew composed of both Vickers and Bomber Command personnel. Bomber Command would also organise teams of service personnel to be stationed at Christchurch and at the intermediate stops with supplies of fuel, oil and equipment for a rapid turnaround. In the coming months Bomber Command staff would practice rapid refuelling with the Valiant.

Concrete runways were available at London Airport (where the Valiant would take off) and Karachi but the surface at Djakara would be asphalt. The MoS would try to obtain permission for the Valiant to land and take off from Karachi and Djakarta and arrange for take-offs at 160,000 lb at these fields using RATOG if required (plus also finding sites for use as jettison areas for the expired rocket sticks). The return flight would be in shorter stages but some special equipment would be required for engine starting at all of these stops.

Fuel for the Avon RA.14s would actually total 10,990gals (49,970 lit) with the contents of the wing drop tanks and bomb cell arranged for jettisoning in just a few minutes if needed; during the race it would not be possible to jettison fuel from the wing tanks. The water methanol system would need a 200gals (909 lit) tank mounted aft of the main fuselage fuel tanks and the control system would only discharge when the engines were running at full power. A full water methanol load would be used for one take-off under tropical conditions, the system operating for one and a quarter minutes at a mixture by volume of 30% methanol and 70% distilled water.

Provision was made on the aircraft to attach two Armstrong Siddeley Scarab RATOG devices, one on each side of the fuselage, with each unit comprising seven rocket motors mounted on a 'stick'; the motors were fired electrically by a sequence switch in the cockpit. For ground handling each Scarab unit would be mounted on a trolley fitted with a special cradle, new units being provided at each take-off site. The navigation and radio fit would comprise HF/RF ARI.5332 (with a spare set in the cabin), VHF TR.1935/6 (two sets), RAE suppressed loop type radio compass, Periscopic Sextant Mk.II, ARI.5851 (Green Satin for ground speed), API Mk.1A, AMU Mk.IV and B3 Drift Meter. The main undercarriage's half forks and rams would be changed for production examples which incorporated new jacking positions that enabled wheel changing to be done with small jacks rather than Ski Hi jacks which lifted the whole aeroplane.

As of 27th February 1953 the Air Ministry had seven months to prepare for the flight and this period was divided into G (ground) and F (flight) programmes as follows:

G1 (week commencing March 2, 9, 16, 23 and 30) – completion of RA.14 installation and wiring for resonance tests, fit accelerometers and measure control surface angles.

F1 (week commencing April 6, 13, 20, 27, May 4, 11 and 18) – engine handling flights, aircraft handling and performance in 'clean' condition without drop tanks plus RATOG tests (34 rocket motors to be provided).

G2 (week commencing May 25 and June 1) – fit flight test drop tanks (which were not usable for the fuel system) and carry out ground resonance tests with these tanks.

F2 (week commencing June 8, 15 and 22) – aircraft handling and performance with these drop tanks and also later with water ballast tanks (in place of long-range bomb tanks) to give the 160,000 lb all-up-weight; RATOG trials included (56 rocket motors to be provisioned).

G3 (week commencing June 29, July 6, 13 and 20) – fit fuel drop tanks and systems, bomb bay fuel tanks, fuel and jettison systems, water methanol tanks and systems up to engine bays, Type 674 half forks and rams to main chassis, modified oxygen system, 2.5gals (11.4 lit) coffee and drinking water tanks for crew, radio and navigation aids and sanitary container and piping.

F3 (week commencing July 27, August 3, 10 and 17) – handling and performance with the final aircraft layout (no water methanol).

G4 (week commencing August 24) – fit RA.14s modified for water methanol injection and complete the water methanol system in the engine bays.

F4 (week commencing August 31, September 7, 14 and 21) – navigation and radio equipment calibration flights, aircrew training plus long-distance flights with the aircraft in its final condition.

G5 (week commencing September 28 and October 5) – final adjustments and inspection before leaving for the starting point and then delivery to the starting point as required by the race conditions.

Final arrangements for staffing the route stations to and including Christchurch were as follows:

London Airport: Vickers' team from Wisley, RAF HQ Detachment and Rolls-Royce representatives;

Karachi: RAF 'Valiant Detachment' Team plus two Vickers and one Rolls-Royce representative;

Djakarta: RAF Team, two Vickers and one Rolls-Royce representative;

Christchurch: RAF Team (the Canberra team transferred from Australia) plus two Vickers and one Rolls-Royce representative.

WB215 seen during preparations for the New Zealand Air Race. Eventually the aircraft was taken out of the race because the internal wing tanks, which were crucial, were not fully serviceable, insufficient testing had been completed and there were some other small problems.

After all of this planning and organisation it is sad to relate that the Valiant did not participate in the New Zealand Race after all. On 24th July 1953 it was grounded to prepare and modify it for the race and, by 25th September, 13 hours of flight tests had been completed with underwing drop tanks and other equipment in place. However, WB215 was unable to complete sufficient flying hours for the Air Ministry to authorise the race flight and so it was withdrawn. In fact, when the event began at Heathrow on 8th October all of the competitors for the high-speed section had been withdrawn except for five Canberras, three flown by the RAF (PR Mk.7 WH773 and PR Mk.3s WE139 and WE142) and two by the RAAF (B Mk.20s A84-201 and A84-202). These all arrived within 15 minutes of one other but the result went to WE139 which covered the distance of 11,792 miles (18,973km) in 23 hours 50 minutes at an average speed of 494.5mph (796km/h). All of the Canberras had to refuel four times.

In comparison the estimated time for WB215 flying the Primary Plan was 23.69 hours and on the Secondary Plan 24.12 hours. The Primary Plan route as finally confirmed would have been London-Shaibah 2,490nm (4,614km) at 475 knots (880km/h) and 30,000ft (9,144m) in 5.33 hours, Shaibah-Cocos Islands 3,800nm (7,041km) at 445 knots (825km/h) and 38,000ft to 48,000ft (11,582m to 14,630m) in 8.56 hours and Cocos-Christchurch 4,300nm (7,968km) at 440 knots (815km/h) and 39,000ft to 49,000ft (11,887m to 14,935m) in 9.8 hours; total distance was 10,590nm (19,623km) in 23.69 hours at an average speed of 447 knots (828km/h).

The Secondary Plan route would have been London-Shaibah 2,490nm (4,614km) at 467 knots (865km/h) and 39,000ft to 47,000ft (11,887m to 14,326m) in 5.39 hours, Shaibah-Negombo 2,300nm (4,262km) at 470 knots (871km/h) and 35,000ft to 45,000ft (10,668m to 13,716m) in 4.96 hours, Negombo-Darwin 3,380nm (6,263km) at 440 knots (815km/h) and 44,000ft to 51,000ft (13,411m to 15,549m) in 7.48 hours and Darwin-Christchurch 2,860nm (5,300km) at 458 knots (849km/h) and 41,000ft to 49,000ft (12,497m to 14,935m) in 6.29 hours total distance 10,930nm (20,253km) in 24 12 hours at an average speed of 453.15 knots (840km/h).

Data Tables

Vickers Valiant Technical Data

Prototype and B Mk.1

Powerplant

Prototype – Four Rolls-Royce Avon R.A.3 turbojets each rated at 6,500 lb (28.9kN) thrust.

Production – Four Avon 204 or 205 rated at 10,050 lb (44.7kN).

Dimensions

Span	114ft 4in	34.8m
Length	108ft 3in	33.0m
Height	32ft 2in	9.8m
Wheel track	30ft 9.5in	9.4m

Areas

Gross wing area	2,362ft²	219.67m²
Horizontal tail plane	380.5ft²	35.39m²
Fin and rudder	263.0ft²	24.46m²

Wing

Aspect ratio	5.54
Aerofoil section	Vickers High Speed

Weights

Empty	75,881 lb	34,420kg
Overload all-up-weight (with drop tanks)	175,000 lb	79,380kg
Max take-off with 10,000 lb bomb	138,000 lb	62,597kg
Maximum landing	98,000 lb	44,453kg

Military Load

One 10,000 lb (4,536kg) bomb (nuclear or conventional) or 21 1,000 lb (454kg) bombs or two fuel tanks of 1,615gals (7,343 lit) each in bomb bay. Max fuel capacity (with u/w drop tanks) 3,972gals (45,342 lit).

Crew

Two pilots, two navigators and one electronics engineer in pressurised cabin.

Performance

At 140,000 lb (63,504kg) weight (inc 10,000 lb bomb but no u/w tanks)

above 30,000ft (9,144m)	Mach 0.84	567-554mph 912-891km/h
at sea level	414mph	666km/h
Max cruising above 30,000ft	Mach 0.82	
Economical cruise at 39,000ft (11,887m)	Mach 0.75	
Initial rate of climb at sea level	4,000ft/min	1,219m/min
Service ceiling	54,000ft	16,459m
on three engines at 110,000 lb (49,896kg) weight	40,000ft	12,192m
Max range with 10,000 lb bomb		
halfway and no reserves	3,450 miles	5,551km
with u/w drop tanks	4,500 miles	7,241km
Stall speed at sea level with 55° flaps		
at 90,000 lb (40,824kg) weight	94mph	151km/h
Take-off to 50ft (15m) height	4,700ft	1,433m
Landing run from 50ft over threshold	5,500ft	1,676m

Prototype Type 660 WB210

Performance

At 90,000 lb (40,824kg) take-off weight (from official Flight Test Reports)

True Air Speed		
at sea level	270 knots	500km/h
at 20,000ft (6,096m)	290 knots	537km/h
at 30,000ft (9,144m)	320 knots	593km/h
at 40,000ft (12,192m)	405 knots	750km/h

Rate of climb		
at sea level	3,500ft/min	1,067m/min
at 20,000ft (6,096m)	2,150ft/min	655m/min
at 30,000ft (9,144m)	1,350ft/min	411m/min
at 40,000ft (12,192m)	550ft/min	168m/min
Time to height		
to 20,000ft (6,096m)	7.5mins	
to 30,000ft (9,144m)	13.3mins	
Stall speed 'clean' aircraft at 81,000 lb (36,742kg) and 21,000ft (6,401m)	94.5 knots	175km/h
Air brake performance at Mach 0.8 – rate of descent at 40,000ft and 85,000 lb (38,556kg) weight	1,900ft/min	579m/min

Valiant B Mk.2

Length	112ft 9in	34.4m

Intended to receive four Rolls-Royce RB.80 Conway bypass jets but WJ954 fitted with Avon R.A.14s. No performance trials were carried out but the maximum speed obtained was 552mph (888km/h) at 1,000ft (305m). Design maximum speed was 665mph (1,070km/h) at sea level.

Aggregate Valiant Drawing Office Man-Hours

Type 660	WB210 to first flight	498,901
Type 667	WB215 to first flight	64,500
Type 674	WP199 (production) to first flight	383,742

Vickers Type Numbers

660	WB210	4 RR Avon R.A.3	Prototype
667	WB215	4 RR Avon R.A.7	2nd Prototype
673	WJ954	4 RR Avon R.A.14	Prototype B Mk.2
674	WP199	4 RR Avon R.A.14	First production
705	WB210	4 AS Sapphires	Type 660 proposed conversion
706		4 RR Avon R.A.28	Production B Mk.1
709	WB215	4 RR Avon R.A.14	Prototype re-engined (New Zealand Air Race)
710		4 RR Avon R.A.28	Production B(PR) Mk.1
712	WJ954	4 RR Conway R.Co.3	Type 673 proposed conversion
716			Studies for military transport
718		4 RR Conway R.Co.2	Production B Mk.2
722		4 RR Avon	Valiant B Mk.III
733		4 RR Avon R.A.28	Production B(PR)K Mk.1
758		4 RR Avon R.A.28	Production BK Mk.1

Valiant Costs

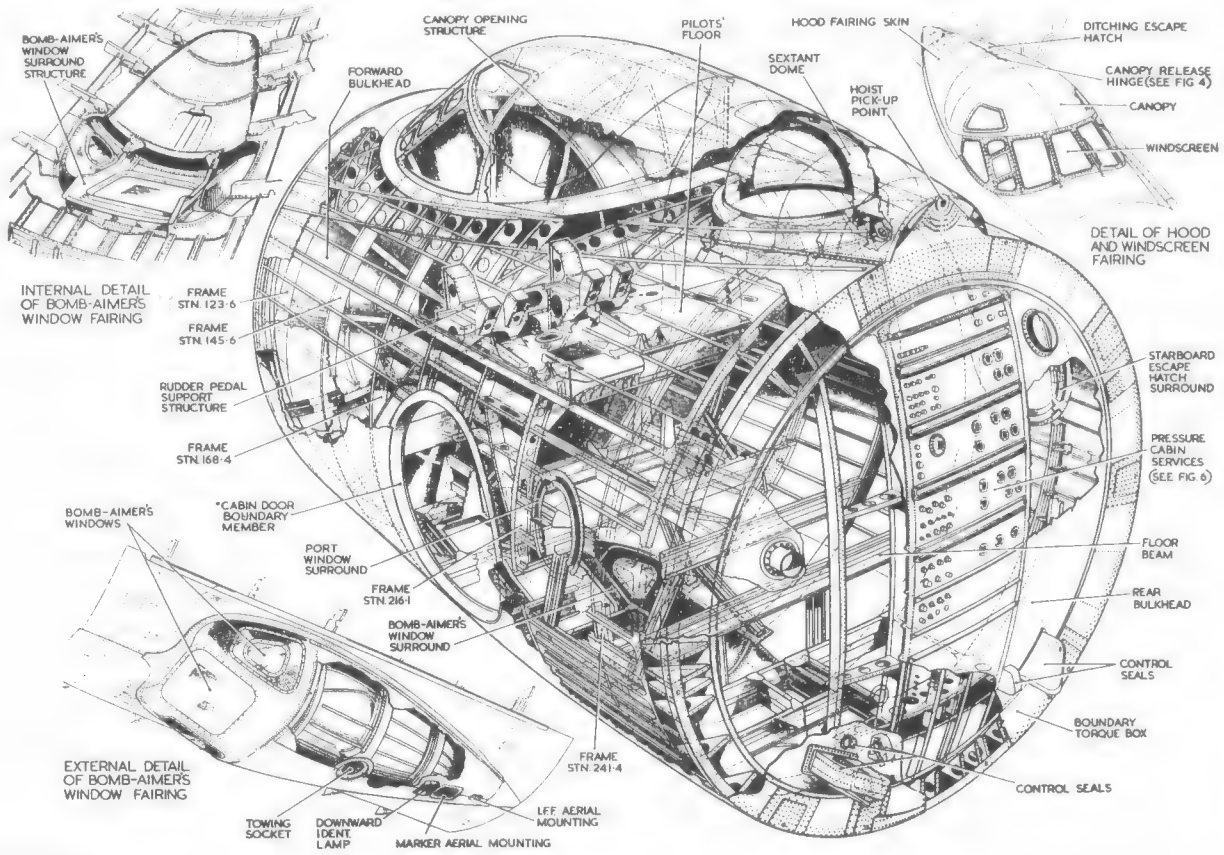
Contract Number		Cost	To Date
6/AIR/7376 & 9446	(35)	£9,146,000	27/7/1956
6/AIR/9446	(33)	£8,626,000	24/8/1956
Note: W/E 14/9/1956 Cancellation of Valiant but only as adjustment to order.			
6/AIR/9446	(30) value now	£9,320,000	28/9/1956
6/AIR/7376 & 9446	(41)	£10,821,000	at 29/6/1956
6/AIR/9446	(29)	£9,070,000	at 26/10/1956
6/AIR/9446	(25)	£8,030,000	at 23/11/1956
6/AIR/9446	(24)	£7,770,000	at 28/12/1956
6/AIR/9446	(10)	£4,130,000	at ?
6/AIR/9446	(3)	£2,674,000	at 28/6/1957
RATOG Conversion		c.£495,000	at 28/3/1958

Valiant Drawings

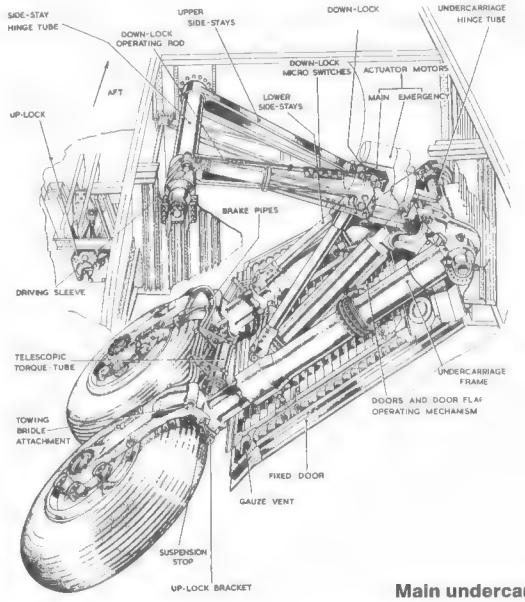
Date	Remarks	Drg No	Spec	RKP No
20/2/47	6-eng high-alt jet bomber	45390	B.35/46	
12/5/47	6 E.131 hg-alt med range	45391/2	B.35/46	
5/47	4 F.9 med-range bomber	45391/13	B.35/46	
14/5/47	6-eng hg-alt bomber (small)	45391/14	B.35/46	83766
14/4/47	6-eng hg-alt bomber (med)	45392	B.35/46	
14/4/47	6-eng hg-alt bomber (large)	45393/1	B.35/46	
17/10/47	4-eng hg-alt bmbr redesign	45398	B.35/46 Rev	85490
	4-eng bomber wing shapes	45398/N	B.35/46 Rev	
	4-eng long-range role	45398/131	B.9/48	
4/3/48	4-eng RAE (ARA) project	65505/6	B.35/46	86766
4/9/48	4-eng Type 660	65507/1	B.9/48	88008/10
16/12/48	4-eng medium range	65515/1	B.9/48	88008/10
12/48	B.9/48 fuselage assembly	65515/3	B.9/48	
25/8/49	4-eng long-range dev.	65530/1	B.9/48	91408
20/11/49	4-eng long-range dev.	65532/1	B.9/48	92267
11/49	4-eng long-range dev.	65533/1	B.9/48	
22/12/49	4-eng lg-rge dev. (P'finder)	65533/2	B.9/48	92736
12/49	Valiant B Mk.1	65537/1A		
1/6/50	Bomber armament	65537/10	B.9/48	94670
12/9/50	Med-range Target Marker	65540/3	B.9/48	95759
5/50	Long-range PRU aircraft	65547/1		
6/50	Long-range PRU aircraft	65547/2		
7/50	Long-range mil transport	65548/1		
2/7/51	Performance data	65549/6	B.9/48	98508
9/51	Long-range mil transport	Rev 65550/2		
1951	Long-range PRU aircraft	65551/1	(tail defence)	
1951	Lg-rge mil transport Mk.II	65553/2	(19 windows)	
5/12/51	Valiant B Mk.1 PRU & pods	65554/1	B.9/48	100091
23/1/52	Low-altitude bomber	65556/1	(tip tanks)	100310
1952	Supersonic bomber	65557/1	(40° sweep)	
3/52	Valiant B Mk.1	655		100866
25/4/52	Valiant B Mk.III	65558/1		A.337
7/12/53	Valiant Grand Slam instal'n	65581		
26/5/54	Valiant 10,000 lb GP instal'n	65587/5		
23/7/54	Val PR Blue Shadow instal'n	65589		
23/2/55	Valiant Green Satin	79904/2	(Interference Cones)	
4/5/55	Valiant rocket missile installation			
26/7/55	Valiant RCM equipment	79908/3	(wing pod installation)	
13/9/55	Val 2,000 lb Target Marker	79909/3	(Inst 4)	
	Valiant 21° & 35° sweep	100942		
4/10/50	Valiant (P) WB210	66000/1		
12/53	Valiant (P) WB215	66700/1		

Note: Way back in 1920 Vickers had begun to allocate a sequential number to its aircraft types. The first Valiant was Type 660 but this was not the end of the story because by now a second series of numbers had evolved (that used two digits) which was attached to the three-digit project number (making five in all). These final digits identified a major part of the aircraft's structure – 01 centre wing section, 03 wing, 04 slats, 07 outer wings, 11 aileron, 16 nacelle, 18 tail plane, 20 elevator, 21 fin, 23 rudder, 27 centre fuselage, 28 front fuselage, 29 rear fuselage, etc. Number 00 identified the three-view general arrangement drawing so 66000 revealed the appearance of the prototype Valiant. As one might expect there could be many of these drawings so a sheet number would often be added – e.g. 66000/1 was Valiant general arrangement Sheet 1 (any modification would make this Sheet 1 Issue B). Most of the drawings in this book are of this type but some miscellaneous scheme drawings might not receive project numbers of their own and so were allocated a convenient 'Type' number – i.e. 453, 655 and 799.

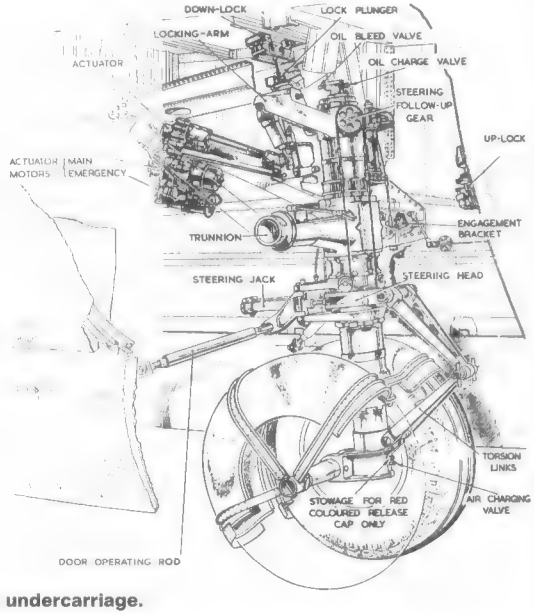
Schematic Drawings



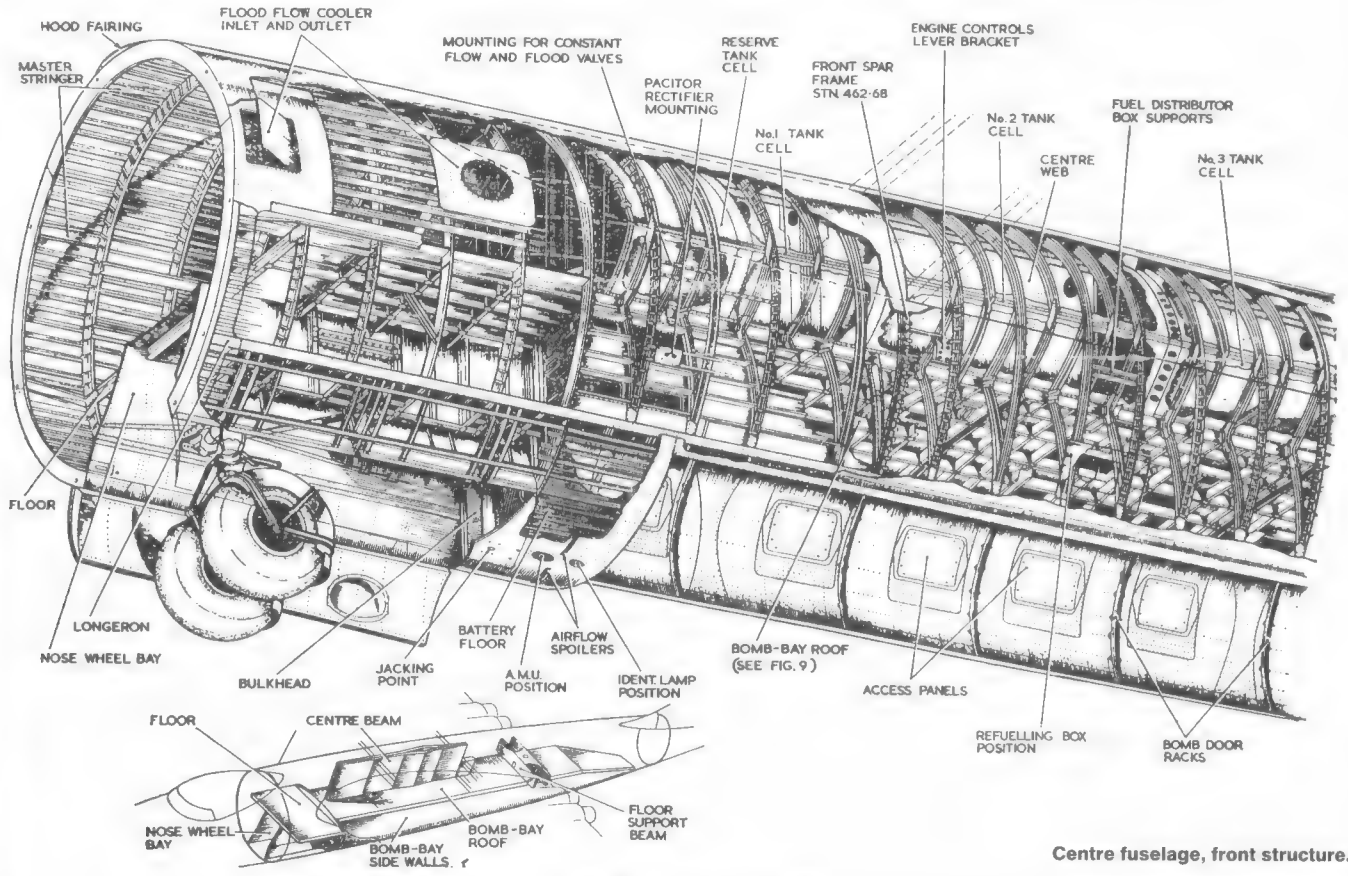
Pressure cabin



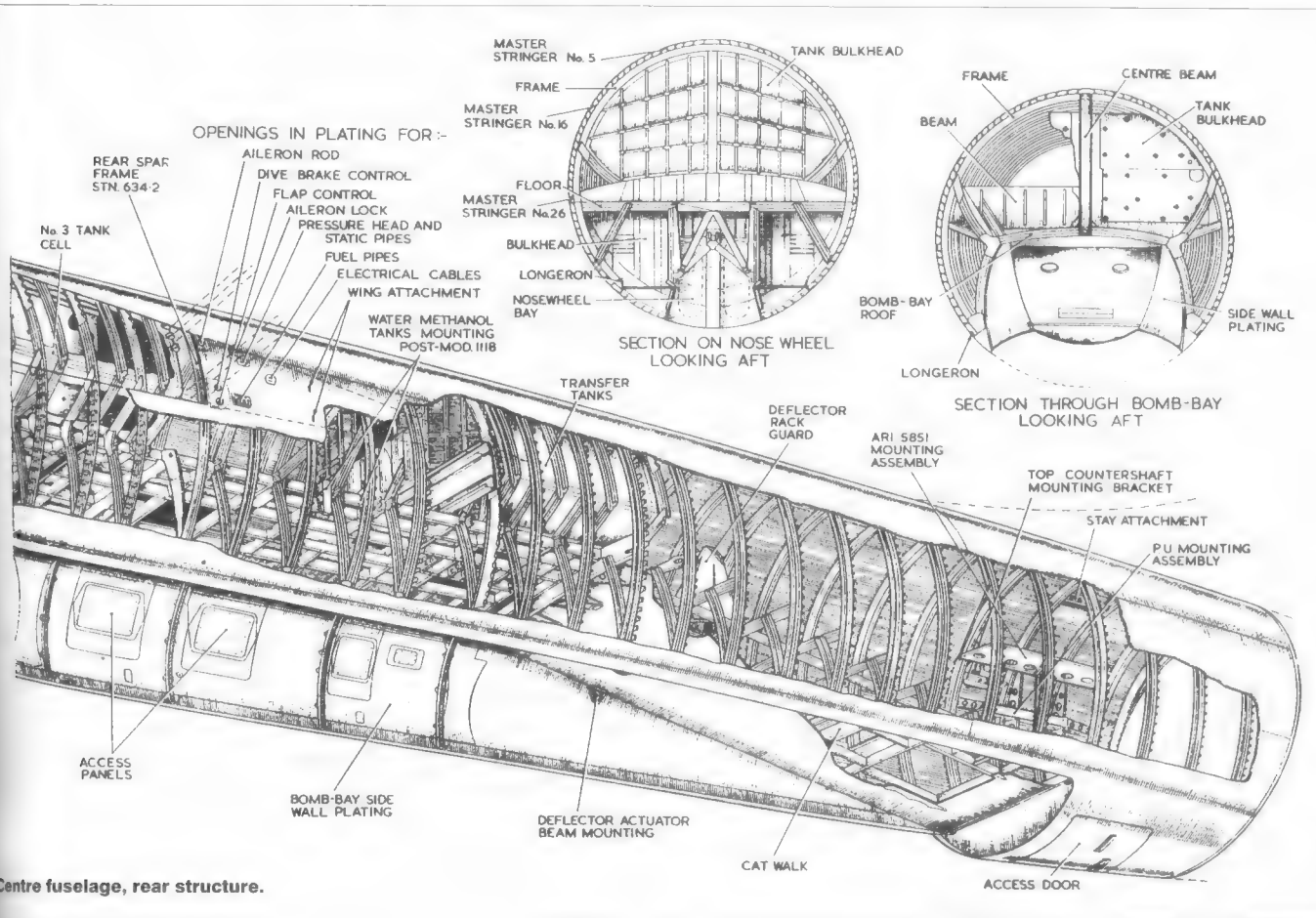
Main undercarriage.



Nose undercarriage.

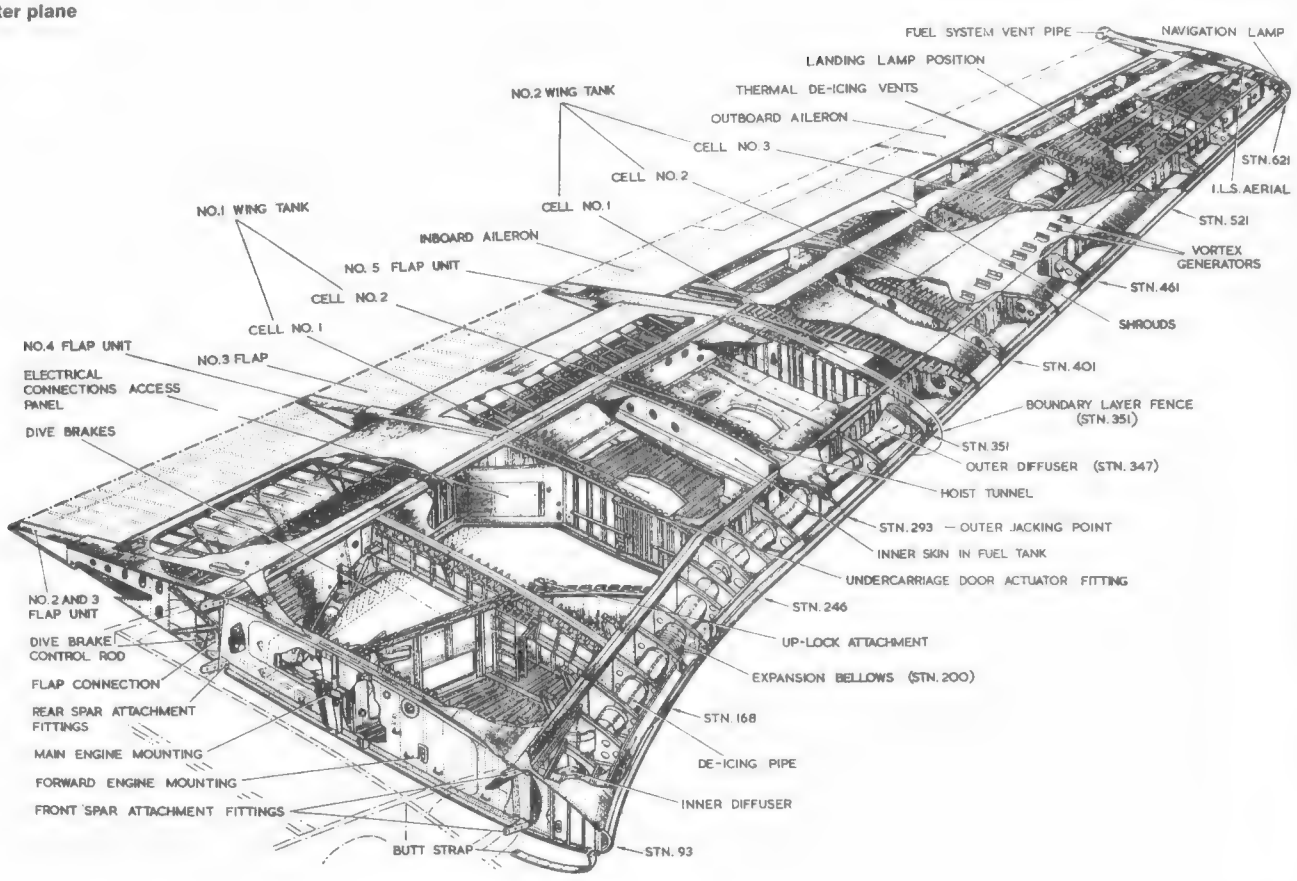


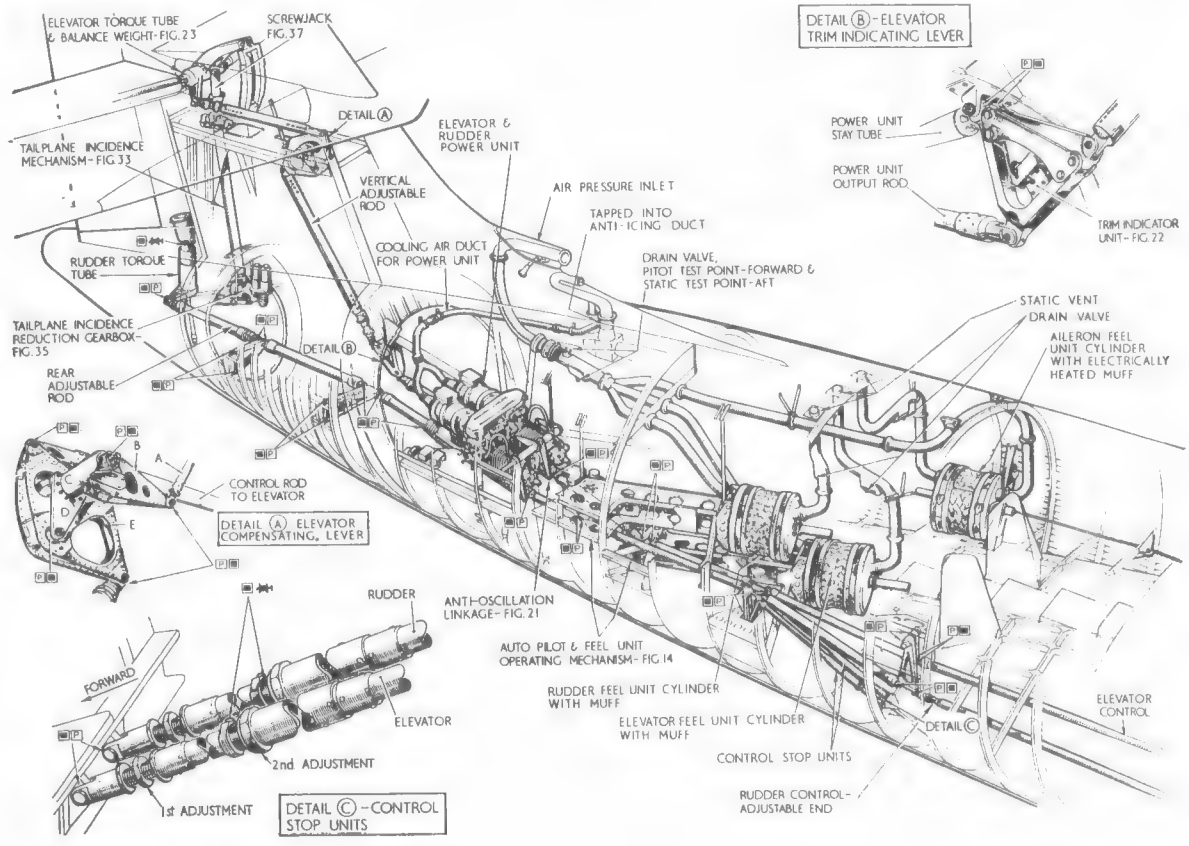
Centre fuselage, front structure.



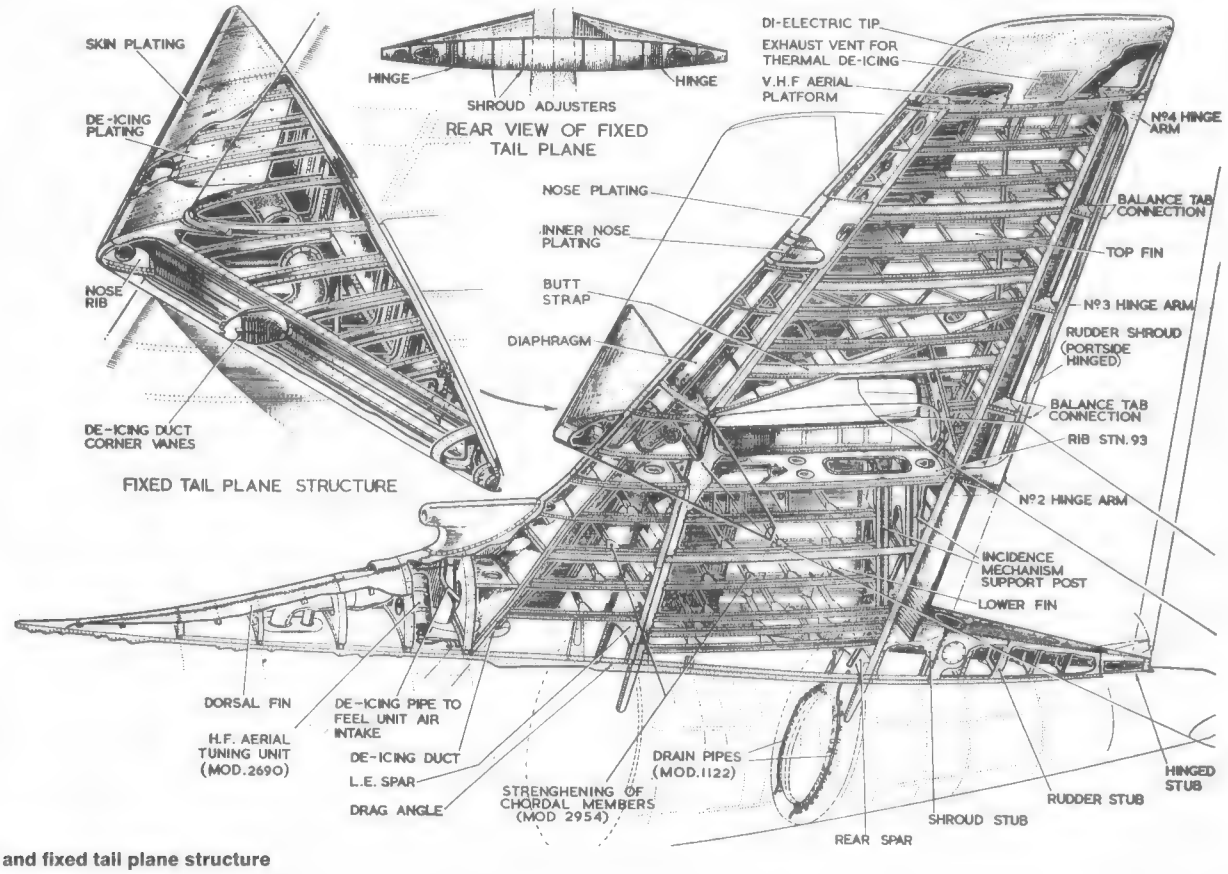
Centre fuselage, rear structure.

Outer plane



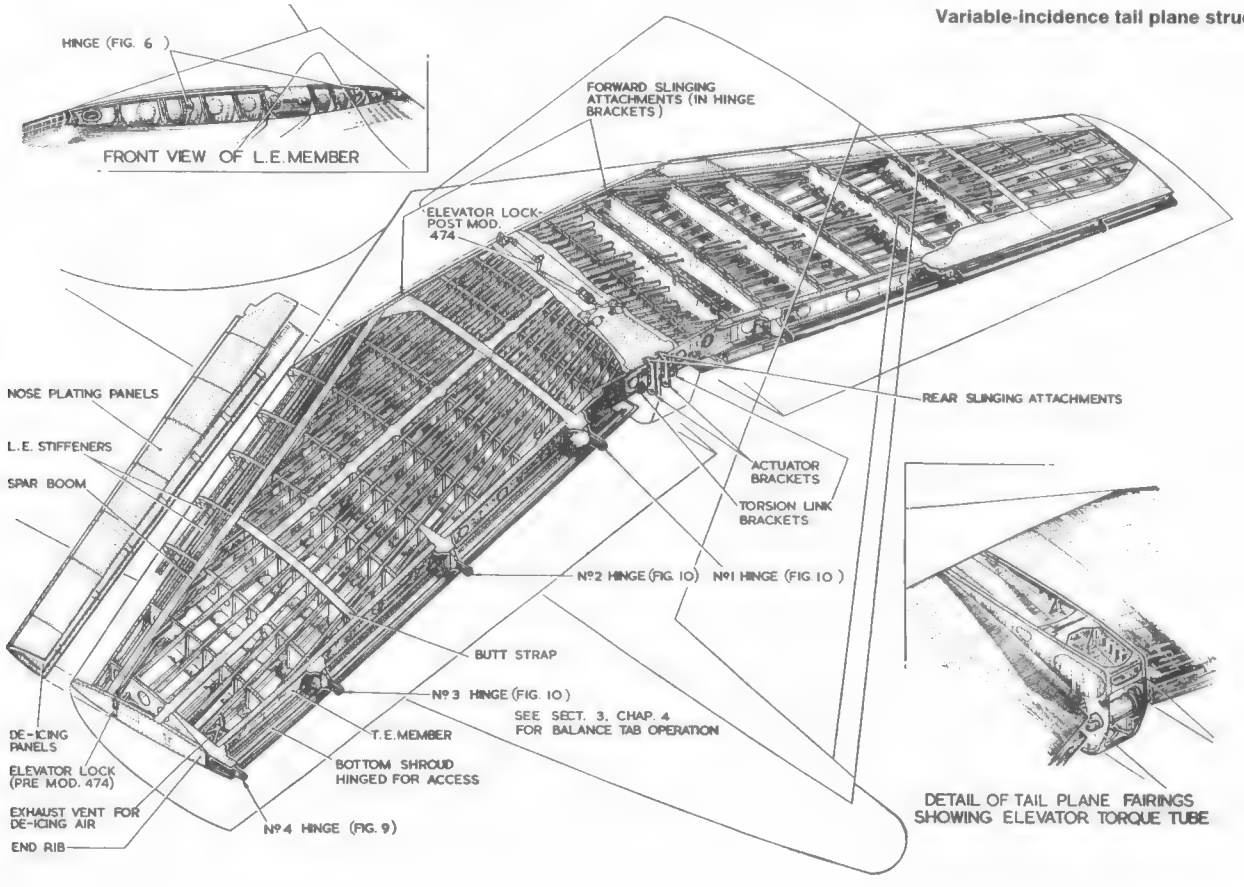


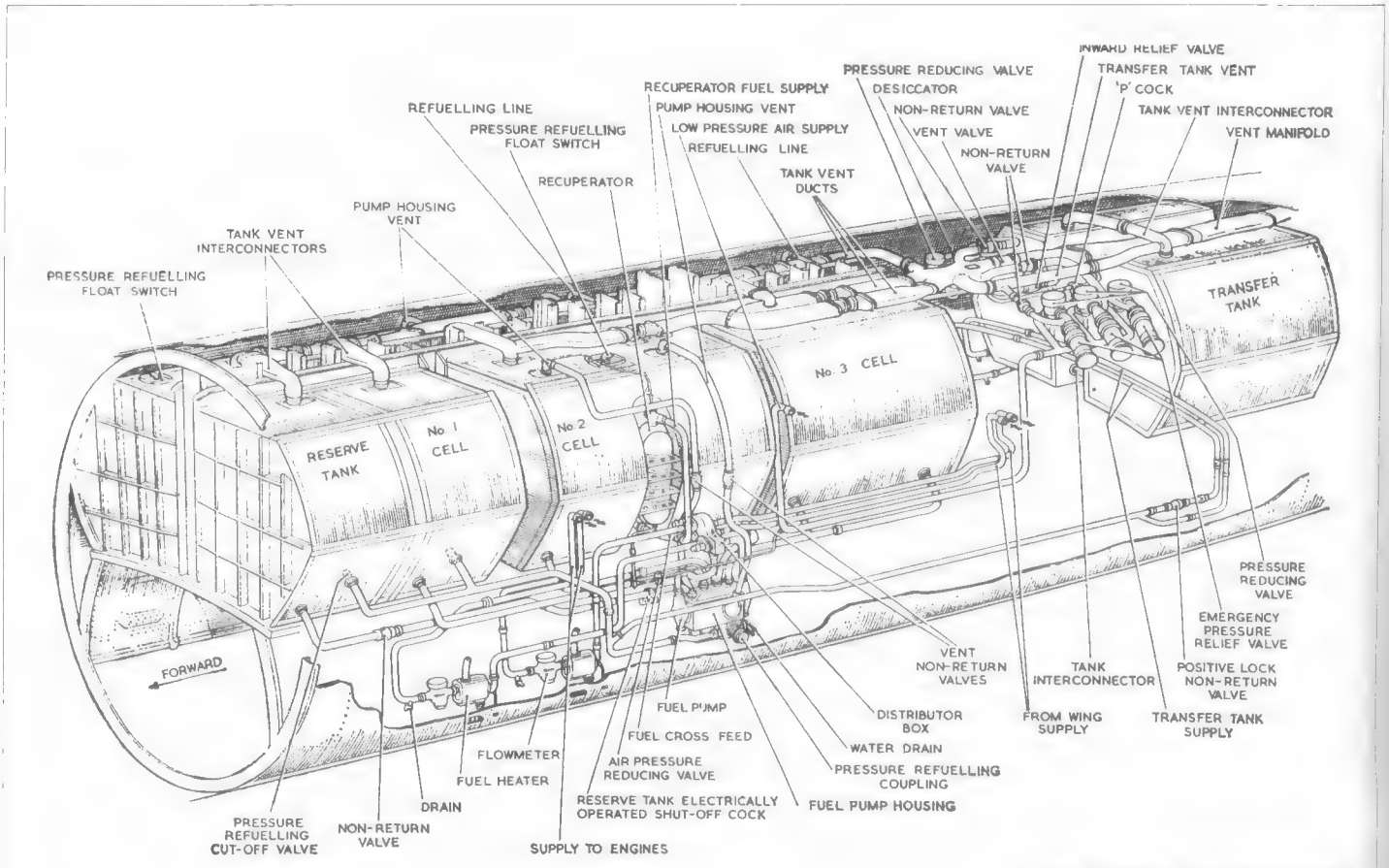
Controls in rear fuselage



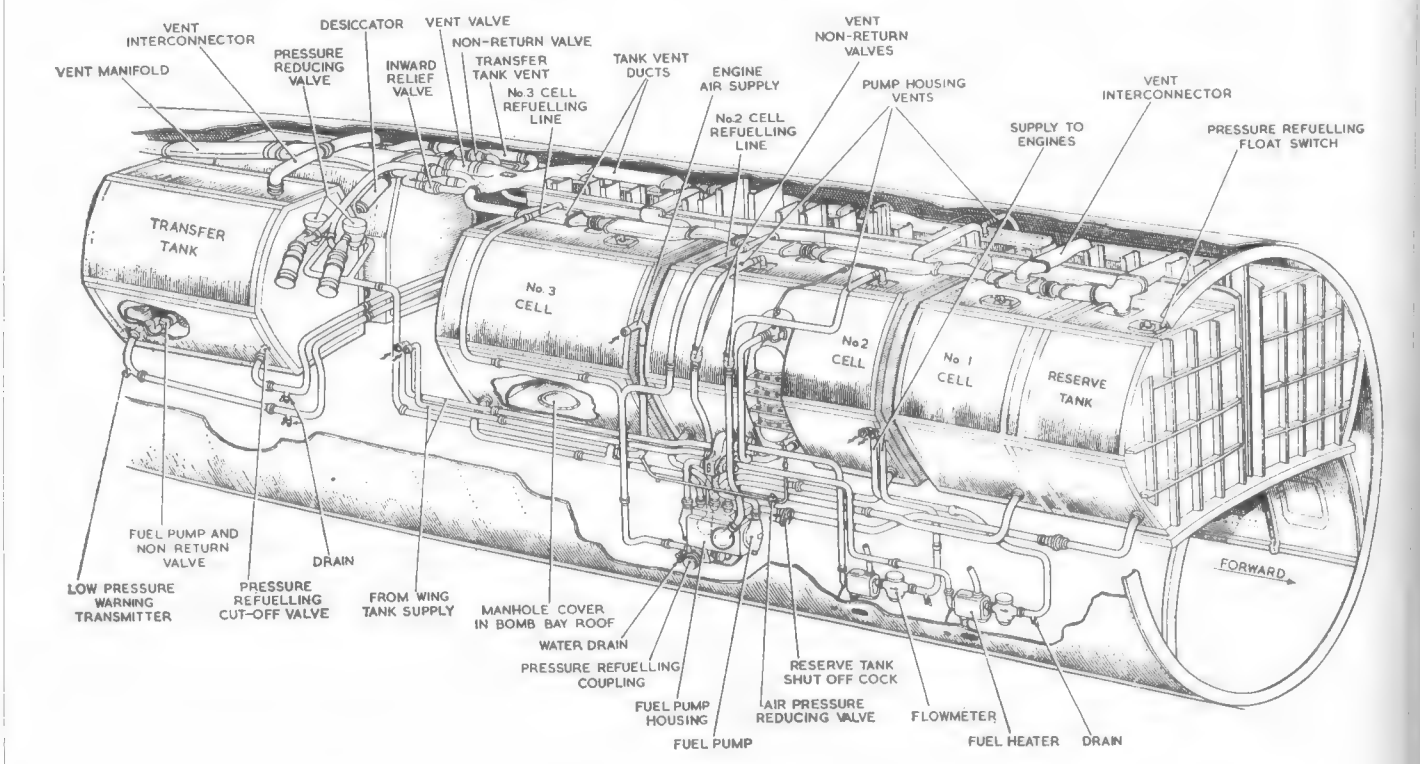
Fin and fixed tail plane structure

Variable-incidence tail plane structure

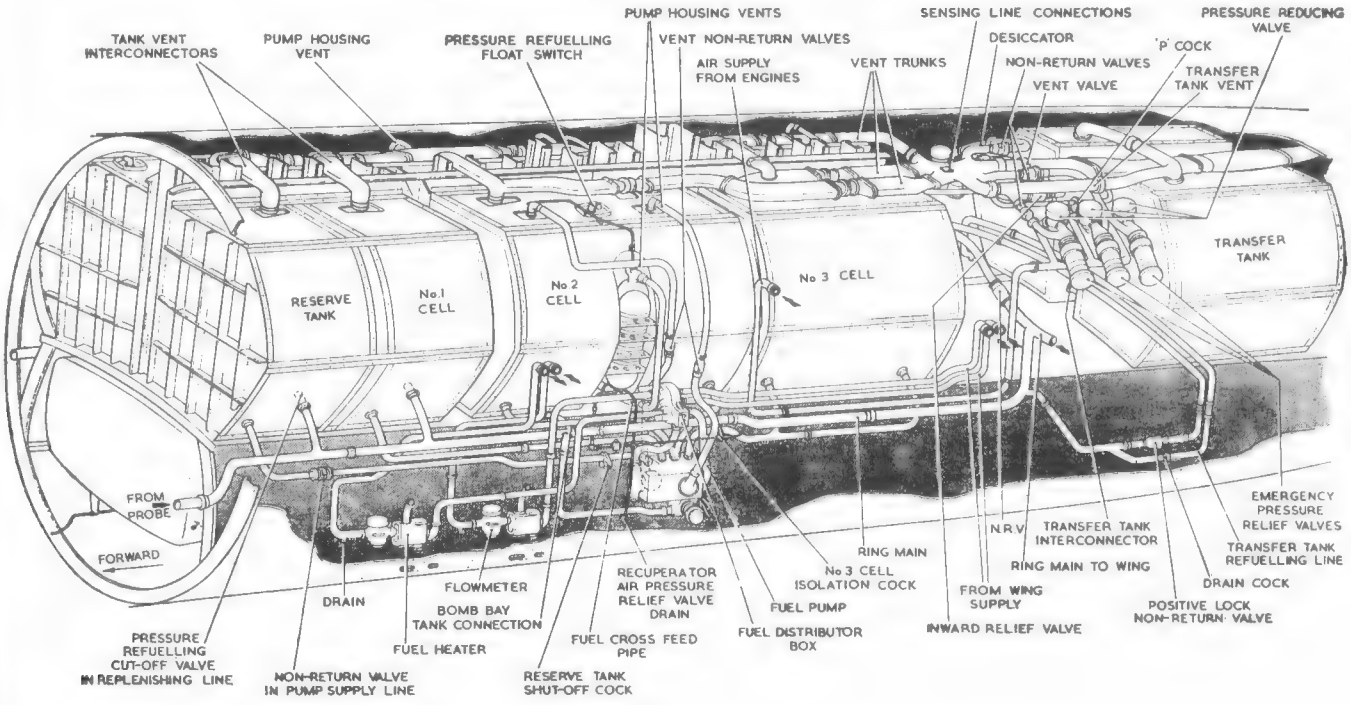




B Mk.1 fuselage fuel system, port side

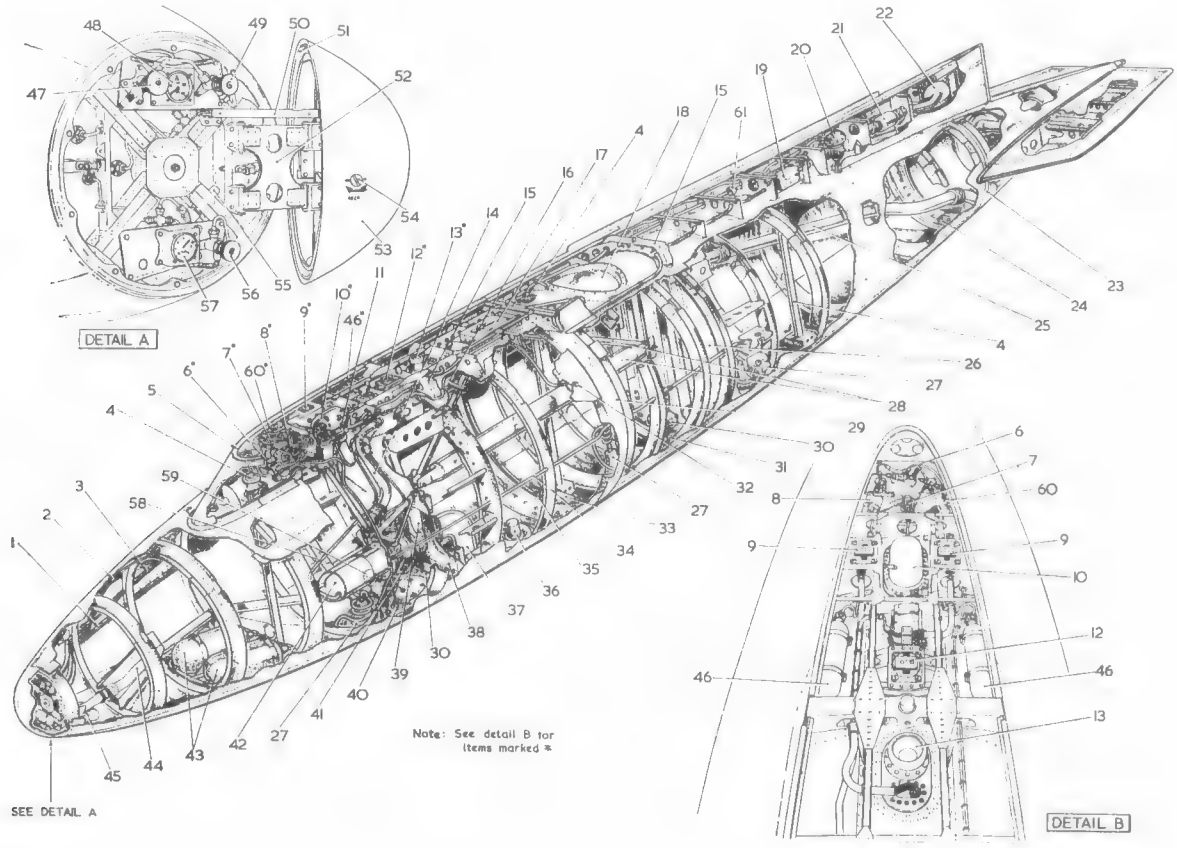


B Mk.1 fuselage fuel system, starboard side

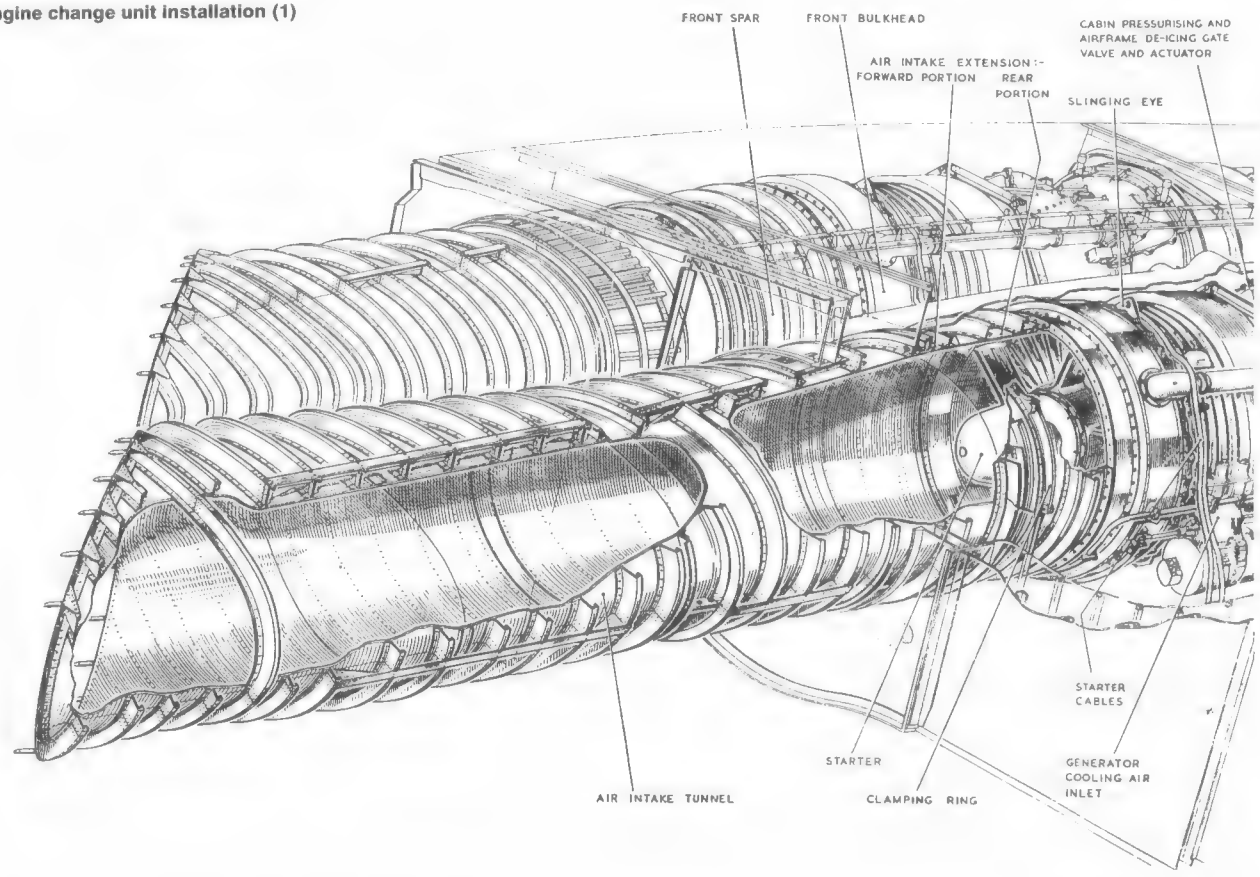


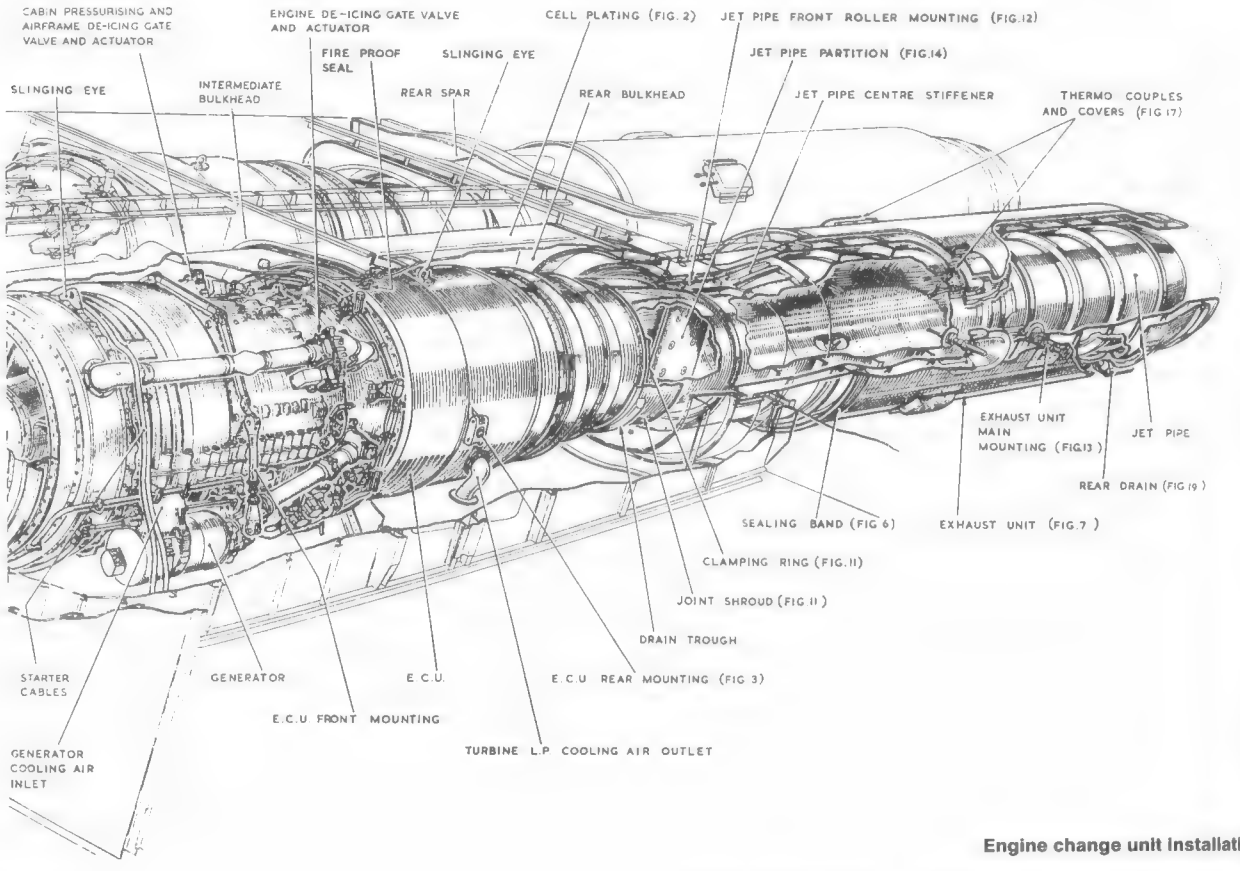
BK Mk.1 and B(PR)K Mk.1 fuselage fuel system, port side

Underwing tank



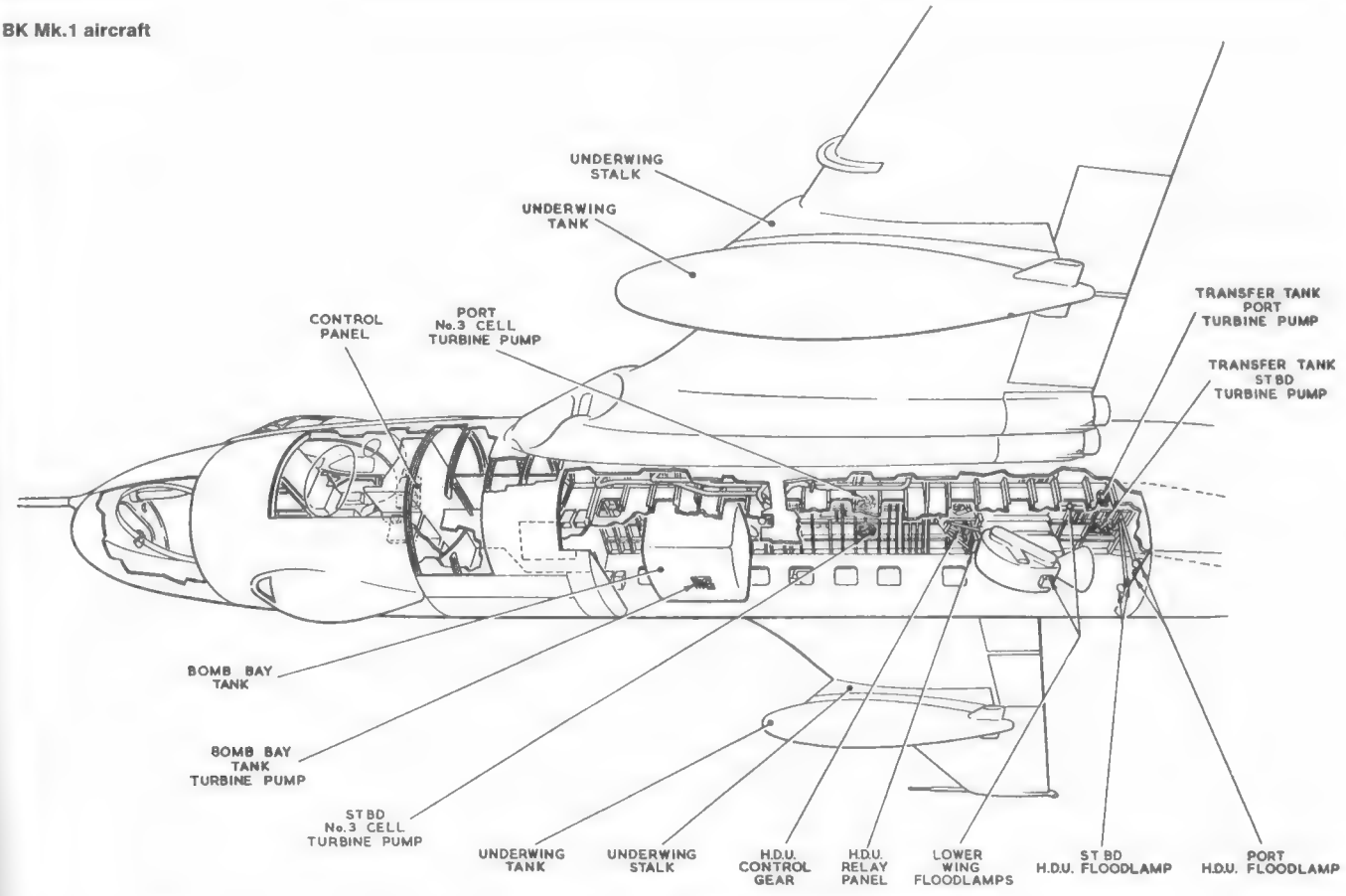
Engine change unit installation (1)

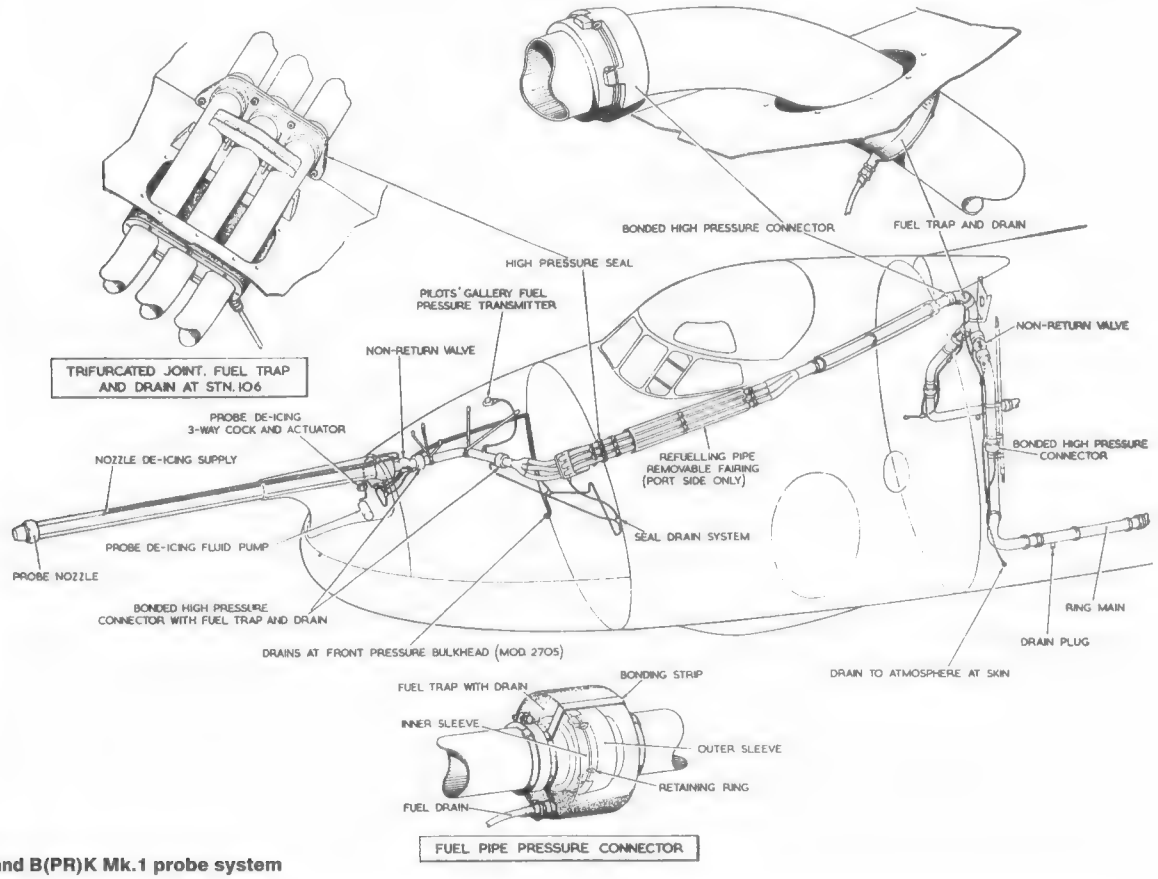




Engine change unit installation (2)

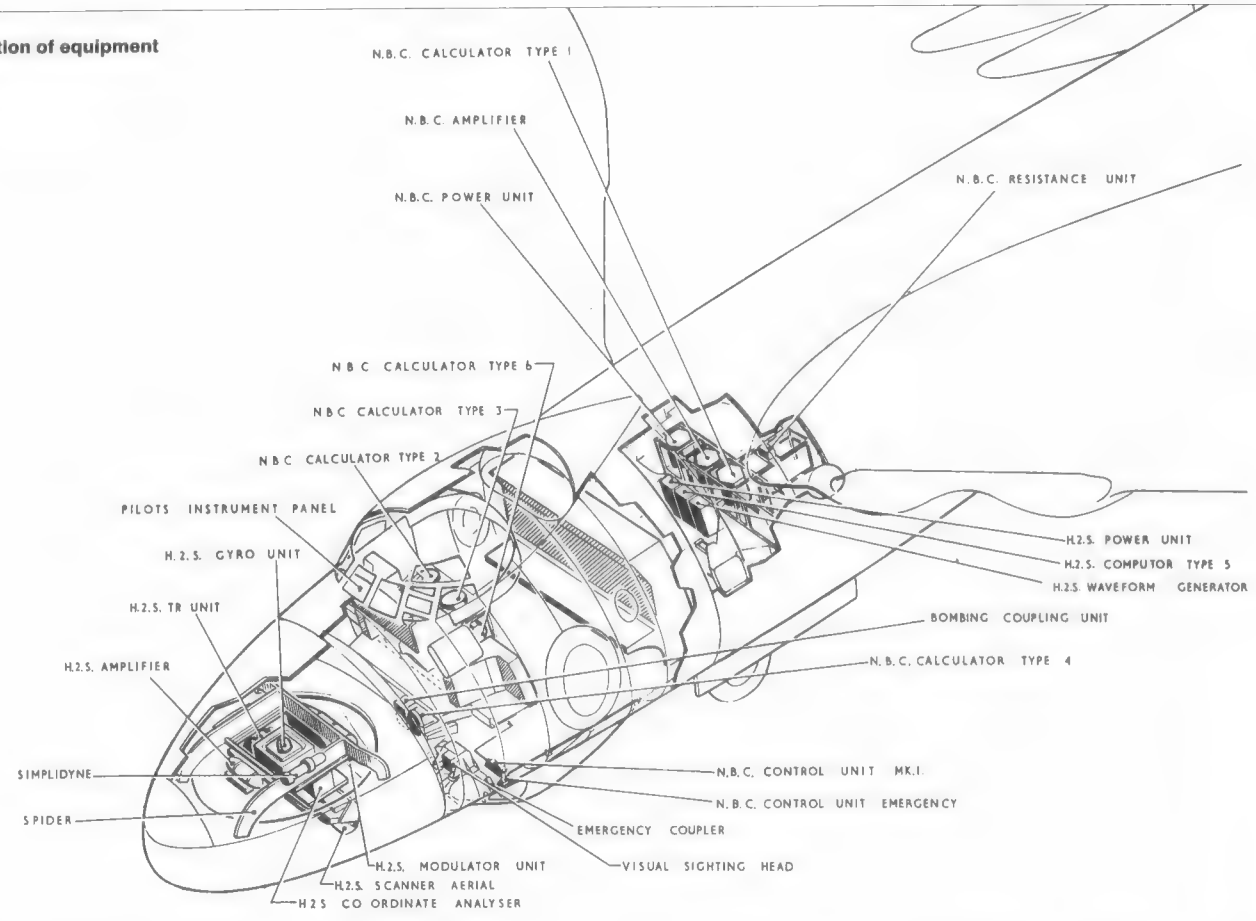
BK Mk.1 aircraft



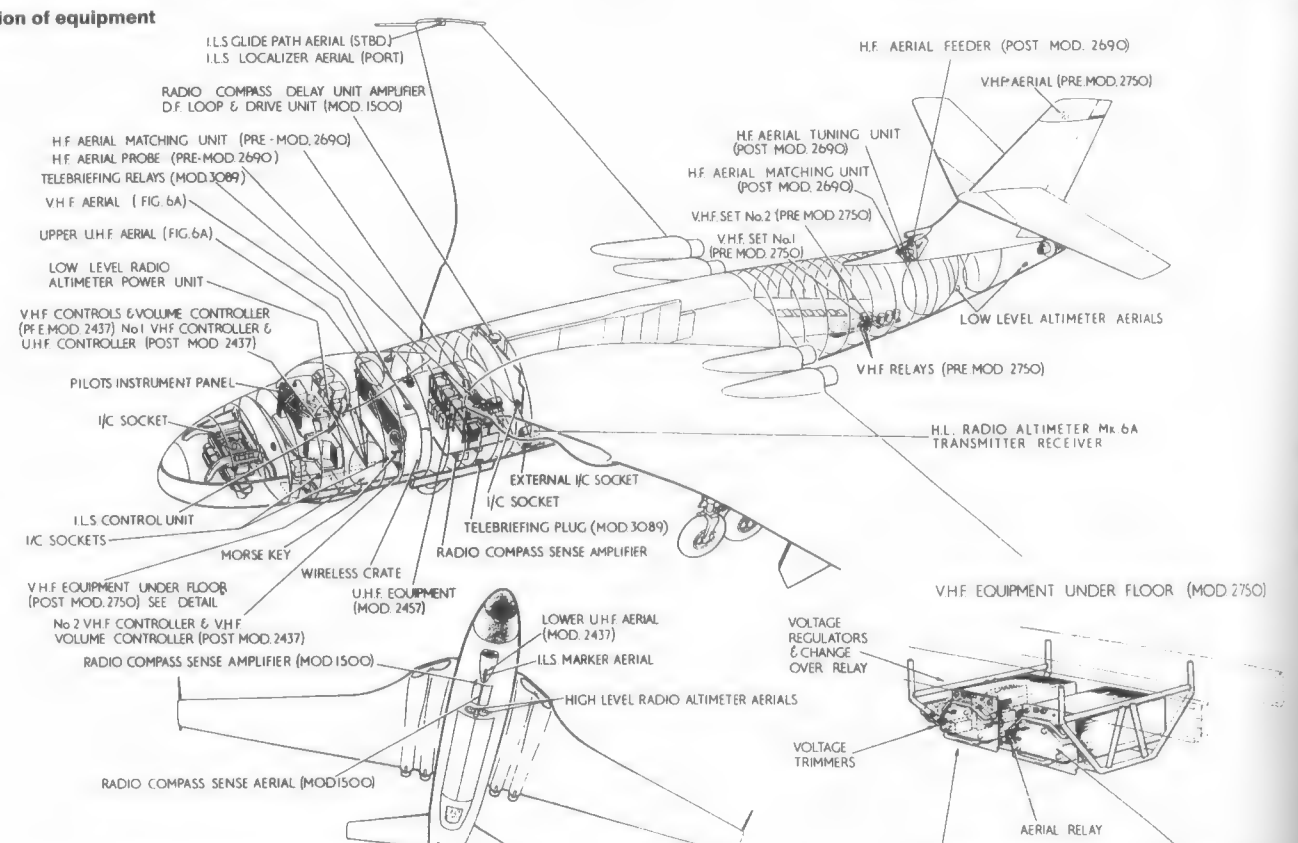


BK Mk.1 and B(PR)K Mk.1 probe system

Location of equipment



Location of equipment



Keys to illustrations on page 116 and 117 – External markings (1) and (2)

(1) The standard colour for external markings is blue and the lettering is normally 0.25 in. high. Departures from these two standards are shown in the Key or in the illustration.
(2) Standard symbols are shown in A.P.2656A, Vol. 1 (2nd Edn.), Sect. 4, Chap. 3.; (3) Post-Mod. 3105, all paints used on engine doors are to conform to Spec. D.TD.900/4700.

No.	Location	Detail (actual markings in capitals)
1	Scuttle forward of windscreen	Matt black finish to D.T.D.314
2	Fuselage upper surface, Stn. 270	Slinging point. Standard symbol
3	Aft of canopy	DINGHY RELEASE. TO RELEASE, OPEN DOOR, PULL HANDLE FREE FROM CABLE ◀ Post-Mod. 2932, CLOSED, TO OPEN. ½ in. lettering with a directional arrow 1½ in. long on dinghy hatch (*detail F*). ▶
4	Forward of walkway	Loop aerial. Finish as for radomes (*A.P.2662B, Chap. 9.4.1.*)
5	Fuselage upper mid-surface	Hoist points (*Detail* A) in red. Handle representation to be forward at No.2, 3 and 5 points (and No.7 on B/PR Mk.1 aircraft only) and aft at No.1, 4 and 6 points.
6	Main plane upper surface, port & stbd.	D.T.D. paint specification marking. 1 in. lettering
7	Main plane upper surface, port & stbd. outboard of Stn. 93	Access to strong point. CUT ALONG LINES. 1 in. lettering (*Detail* B)
8	Main plane upper surface, port & stbd.	Location for aileron checking gauge. Two dots 0.5 in. dia.
9	Main plane upper surface, port & stbd.	National markings – roundels (*A.P.2656A, Vol. 1 (2nd Edn.), Sect. 4/2*)
10	Main plane upper surface' port & stbd.	Slinging points. Standard symbols
11	Fuselage upper surface	STATIC VENT. 1 in. arrow pointing to each hole
12	Tail plane upper surface	Slinging points. Standard symbols. Aft position marked prior to assembly of fin
13	Tail plane and elevator upper surface	D.T.D. paint specification marking. 1 in. lettering
14	Tail plane upper surface, port & stbd.	Rigging points marked with dots 1 in. dia.
15	Main and tail planes, upper surfaces, port and stbd.	Symmetry screws marked with dots 1 in. dia.
16	Fuselage upper surface	Rear end of walkway post-Mod. 547, Type B/PR Mk.1. Walkway enclosed within blue dotted lines 0.125 in. wide.
17	Fuselage upper surface	Rear end of walkway post-Mod. 457, Type B Mk.1
18	Fuselage upper surface	Rear end of walkway post-Mod. 546, Types B Mk.1 and B/PR Mk.1
19	Main plane upper surface, port & stbd.	Rigging points marked with dots 1 in. dia.
20	Fuselage lower surface, Stn. 1043	Picketing point, standard symbol
21	Fuselage lower surface, Stn. 973	PEACE STEADYING CRADLE (66079 SHT. 33) HERE, STN. 973. Enclosed in thin blue outline
22	Lower mid-fuselage, stbd. side	WATER/METHANOL 70/30 145 GALL. ¾ in. lettering, ¾ in. between lines
23	Flap inboard ends, lower surface	D.T.D. paint specification markings. 1 in. lettering
24	Main plane lower surface	PITOT DRAINS PRESS
25	Main plane lower surface	On the inside of panels, B Mk.1 and B/PR Mk.1 aircraft, REFUELLING MAX DELIVERY PRESS. 50 P.S.I. DEFUELLING MAX SUCTION PRESS. 11 P.S.I. BELOW ATMOS. On the inside of panels, B K/PR Mk.1 aircraft, DEFUELLING SELECTOR VALVE. On the outside of panels, standard symbol all aircraft
26	Main plane lower surface, port & stbd.	Picketing point. Standard symbol
27	Main plane and fuselage lower surface	Jacking points. Standard symbols
28	Undercarriage door, port & stbd.	Access to strong point. CUT ALONG LINES (*Detail* C). 1 in. lettering
29	Main plane lower surface, port & stbd.	D.T.D. paint specification marking. 1 in. lettering
30	Main plane lower surface, port & stbd.	STEADY HERE. 0.5 in. dia. dots
31	Front engine doors	GENERATOR panels
32	Front engine doors	FUEL FILTER panels
33	Front engine doors	GENERATOR COOLING AIR OUTLET
34	Front engine doors	PUMP GOVERNOR panels
35	Front engine doors	Oil filler panels. OIL FILLER 10 PINTS (*Detail* D). Standard symbol and arrow to be painted on skin forward of panels
36	Rear engine doors	Lettering below arrow (*Detail* E) to be in red, on adjacent skin
37	Rear engine doors	Igniter and oil level panels. OIL LEVEL. Methyl bromide symbol in red enclosed by thin line
38	Rear engine doors	D.T.D. paint specification. 1 in. lettering
39	Rear engine doors	Methyl bromide panels. Standard symbols in red
40	Rear engine doors	CHECK SLIP PIN WITHDRAWN BEFORE LOWERING DOOR. 0.5 in. red lettering

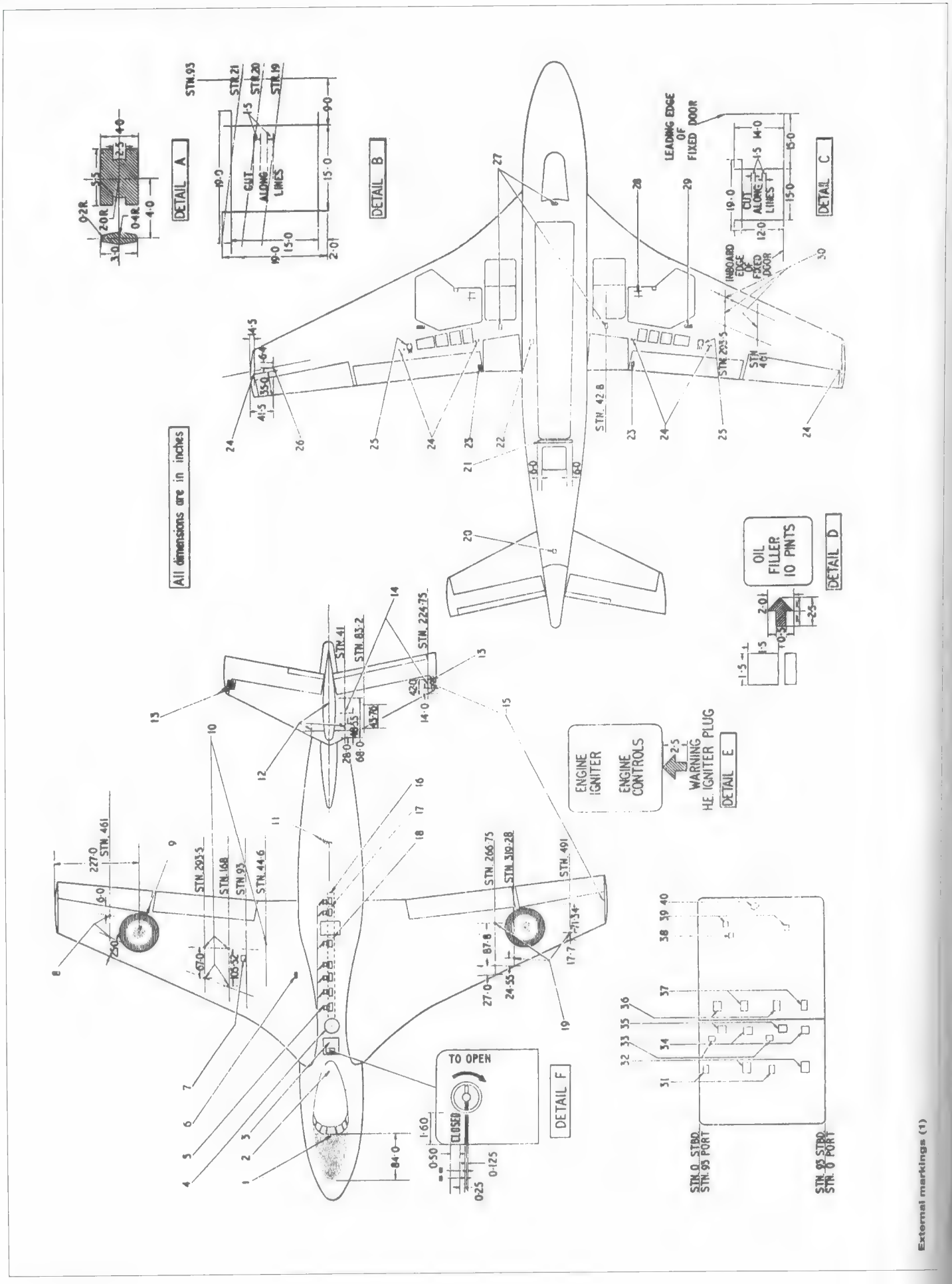
No.	Location	Detail (actual markings in capitals)
1	Near refuelling probe	De-icing replenishment point, B/K/PR Mk.1 and B/K Mk.1 aircraft only. Standard symbol
2	Fuselage starboard side	De-icing replenishment. Standard symbol
3	Fuselage port and starboard	STATIC VENT with 1 in. long arrow pointing to each hole
4	Fuselage port side	Cabin door external view (*Detail* A). CUT HERE FOR EMERGENCY RESCUE close to segmented line; FIRST-AID AND AXE STOWED INSIDE between axe shaft outline and door edge
5	Fuselage port side	Ejection seat warning standard symbol. See Detail A for location
6	Fuselage starboard side	Emergency exit (*Detail* B). TO OPEN EMERGENCY EXIT PRESS HERE, PULL HANDLE RIGHT OUT. TURN-THEN PUSH on lower part of door
7	Fuselage starboard side	Air conditioning ground connection. Standard symbol
8	Fuselage port side	EXTERNAL SUPPLY 112 AND 28v and standard symbol on outside of panel
9	Fuselage port side	MIC-TEL SOCKET. 0.5 in. lettering on inside of panel
10	Fuselage port side, forward of and level with external supply panel	WARNING: SWITCH OFF GENERATORS 1, 2 and 3 and ROTARY TRANSFORMERS 1 and 2 BEFORE INSERTING EXTERNAL SUPPLIES
11	Fuselage port side	D.T.D. paint specification. 1 in. lettering
12	Fuselage port and stbd. sides	Roundels (*A.P.2656A, Vol. 1 [2nd Edn.]~ Sect. 4 Chap. 2*)
13	Fuselage port and stbd. sides	Serial number (*A.P.2656A, Vol. 1 [2nd Edn.]~ Sect. 4 Chap. 2*)
14	Fin port and stbd. sides	National markings (*A.P.2656A, Vol. 1 [2nd Edn.]~ Sect. 4 Chap. 2*)
15	Fin port and stbd. sides	Slinging poirts. Standard symbols
16	Fin and rudder port side	D.T.D. paint specification markings. 1 in. lettering
17	Fin port side	Incidence markings (*Detail* D)
18	Fuselage port side, Stn. 703	Fuel filter de-icing (pre-Production aircraft only). Standard symbol
19	Wheels and tyres	Tyre creep detection marks (*A.P.2337, Vol. 1, Book 2, Sect. 2, Chap. 2*)
20	Fuselage port and stbd., Stn. 528	REFUELLING MAX. DELIVERY PRESS 50 P.S.I. DEFUELLING MAX. SUCTION PRESS 11 P.S.I. BELOW ATMOS. B Mk.1 and B/PR Mk.1 aircraft only on outside of panels. DEFUELLING SELECTOR VALVE on B/K Mk.1 and B/K/PR Mk.1 aircraft only on inside of panels. On the outside of panels, standard symbol on all aircraft
21	Fuselage port side, aft panel above nose wheel door	Oxygen point. 1800 LB/SQ. IN. 126.5 KGMS/SQ. CM. and standard symbol
22	Fuselage stbd. side, aft panel above nose wheel door	Pneumatic point. 1800 LB/SQ. IN. 126.5 KGMS/SQ. CM. MAX. Nitrogen point. 1800 LB/SQ. IN. 126.5 KGMS/SQ. CM. Standard symbols for each
23	Nose wheel	Tyre creep detection marks (*A.P.2337, Vol. 1, Book 2, Sect. 2, Chap. 2*)
24	Fuselage port side, forward panel above nose wheel door	PRESSURIZATION TEST POINT. 1 in. red letters on inner face of panel
25	Fuselage stbd. side, forward panel above nose wheel door	Hydraulic point standard symbol
26	Fuselage port side above bomb-aimer's fairing	D.T.D. paint specification marking. 1 in. lettering
27	Underwing tank nose cap	Pneumatic point. 450 LB/SQ. IN. 32 KGMS/SQ. CM. MAX. below standard symbol NITROGEN 1800 LB/SQ. IN. 126.5 KGMS/SQ. CM. below standard symbol
28	Port underwing tank nose cap	Lock (*Detail* C). Arrow points forward
29	Starboard underwing tank nose cap	Lock (*Detail* C). Arrow points aft

Keys to illustrations on pages 118 and 119 – External markings (1) and (2), camouflaged aircraft

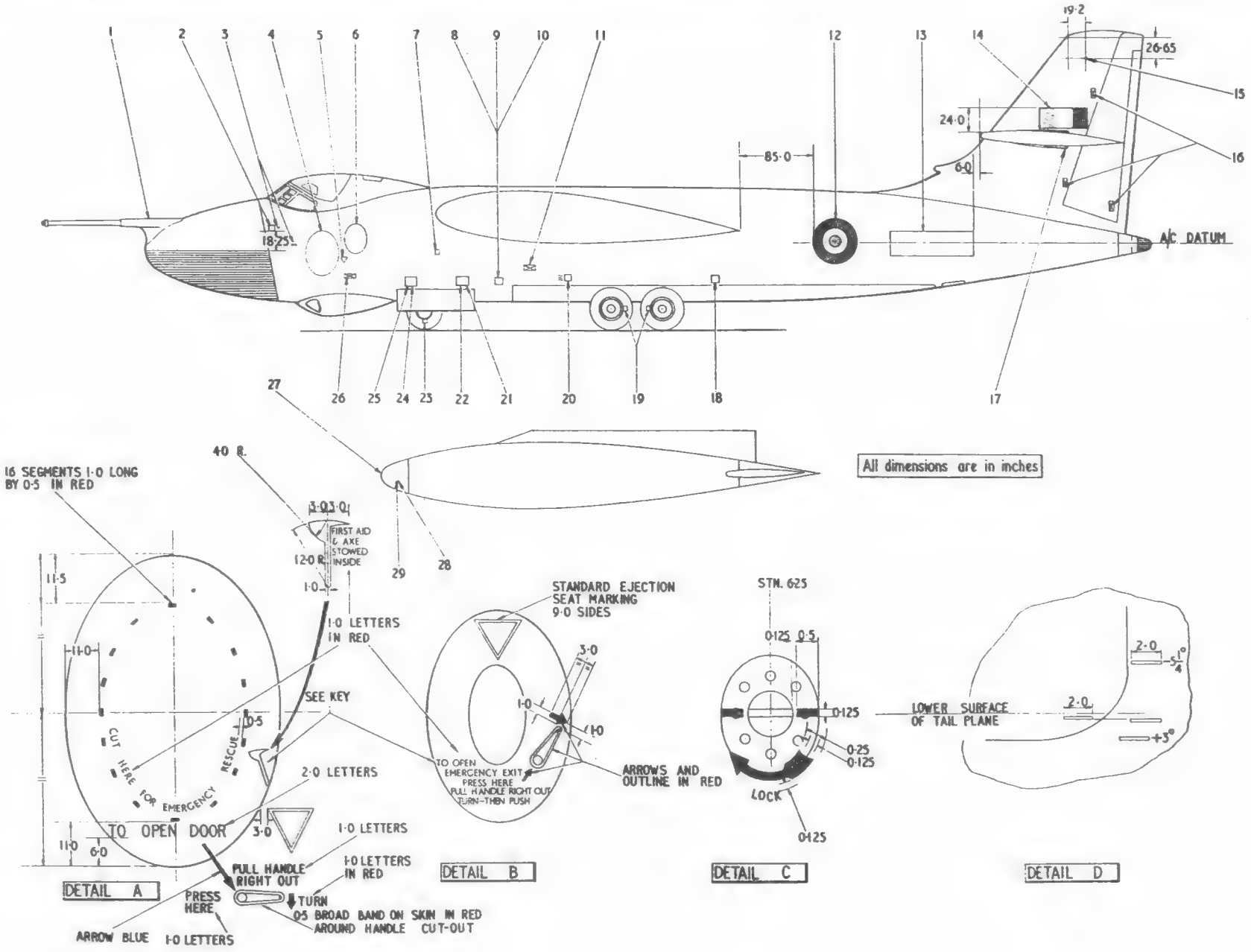
(1) The standard colour for external markings on camouflaged surfaces is to be yellow and the lettering is normally 0.25 in. high. Departures from these two standards are shown in the Key or on the illustration.
(2) All undersurface markings are as indicated on fig. 14. [this refers to the illustration on p116]; *(3) Standard symbols are shown in A.P.2656A, Vol. 1 (2nd Edn.), Sect. 4, Chap. 3.*

No.	Location	Detail (actual markings in capitals)
1	Tail plane upper surface, port & stbd.	Rigging points marked with dots 1 in. dia. See fig. 14, item 14, for location
2	Tail plane and elevator upper surface	D.T.D. paint specification markings. 1 in. lettering.
3	Tail plane upper surface, port & stbd.	Symmetry screws marked with dots 1 in. dia.
4	Tail plane upper surface, port & stbd.	Slinging points. Standard symbols 1.50 in. across base. Aft position marked prior to assembly of fin.
5	Fuselage upper surface	STATIC VENT. 1 in. arrow pointing to each hole.
6	Fuselage upper surface	Rear end of walkway post-Mod. 574, Type B/PR Mk.1. Walkway enclosed with yellow dotted lines 0.125 in. wide.
7	Fuselage upper surface	Rear end of walkway post-Mod. 547, Type B Mk.1.
8	Fuselage upper surface	Rear end of walkway post-Mod. 546, Types B Mk.1 and B/PR Mk.1.
9	Main plane upper surface, port & stbd.	Slinging point Standard symbol.
10	Main plane upper surface, port & stbd.	National markings – roundel (*Detail* D).
11	Main plane upper surface, port & stbd.	Symmetry screws marked with dots 1 in. dia.
12	Main plane upper surface, port & stbd.	Aerial cover. To be painted to suit camouflage pattern in D.T.D. 900/4153.
13	Main plane upper surface, port & stbd.	Rigging points marked with dots 1 in. dia. See fig. 14, item 19, for location dimensions.
14	Main plane upper surface, port & stbd.	Slinging points. Standard symbol.
15	Scuttle forward of windscreen	Matt green finish to D.T.D. 314B.
16	Fuselage upper surface, port & stbd.	Slinging point. Standard symbol.
17	Aft of canopy	DINGHY RELEASE TO RELEASE OPEN DOOR PULL HANDLE FREE FROM CABLE (*Detail* A).
18	Foward of walkway	Loop aerial. Finish as for radomes (A.P.2662B, Chap. 9, 4, 1).
19	Fuselage upper mid-surface	Hoist points (Detail B) in yellow. Handle representation to be forward at No.2.
20	Main plane upper surface, port & stbd.	D.T.D. paint specification marking. 1 in. lettering.
21	Main plane upper surface, port & stbd., outboard of Stn. 93	Access to strong point. CUT ALONG LINES. 1 in. lettering (*Detail* C).
22	Main plane upper surface, port & stbd.	Location for aileron checking gauge. Two dots 0.5 in. dia. See Fig. 14, item 8, for location dimensions.

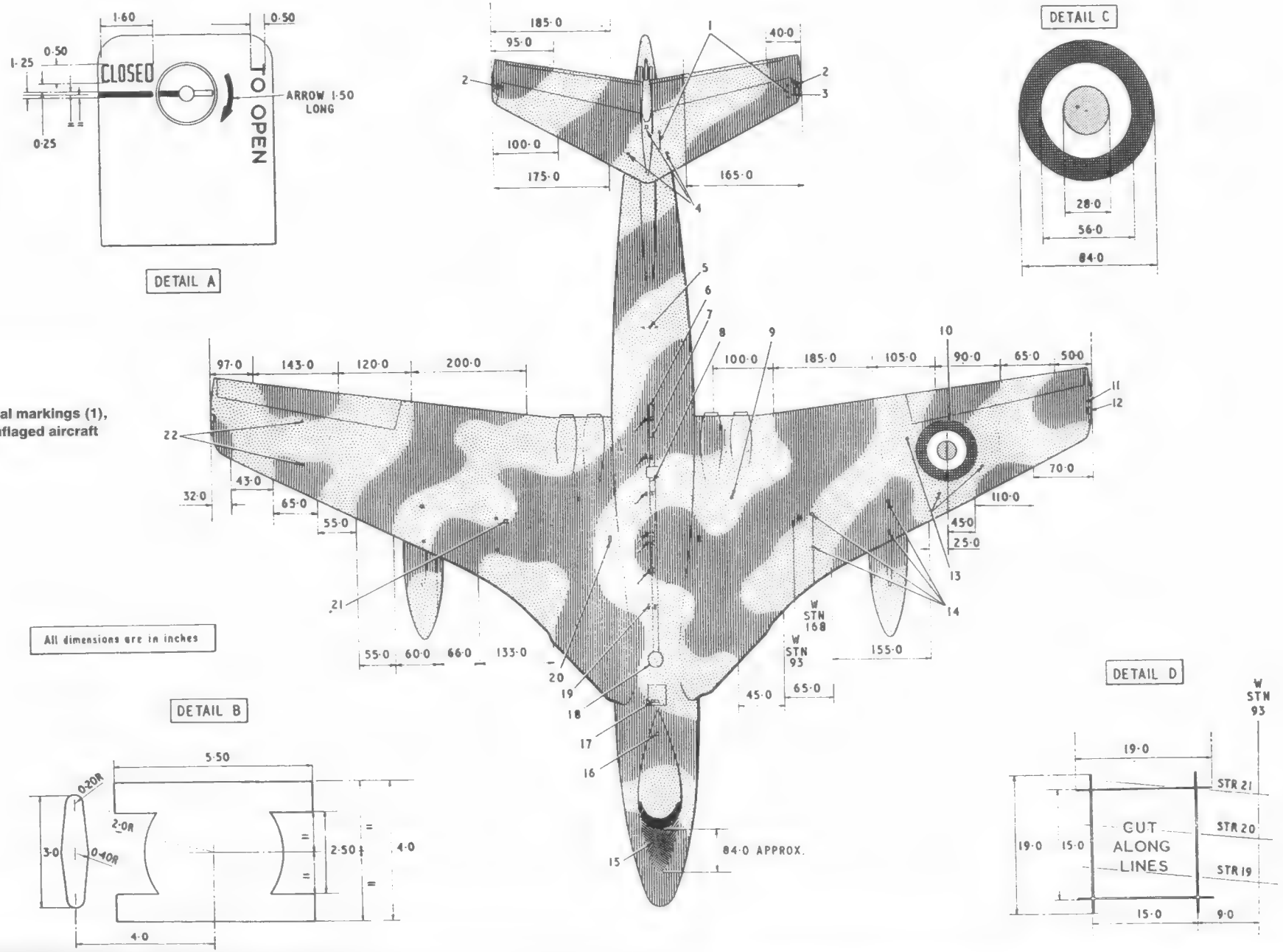
No.	Location	Detail (actual markings in capitals)
1	Near refuelling probe	De-icing replenishment point, B/K/PR Mk.1 and B/K Mk.1 aircraft only. Standard symbol, 1.50 in. triangle.
2	Nose	Scanner bonnet fasteners. (*Detail* D).
3	Front fuselage	STATIC VENT with 1 in. long arrow pointing to hole.
4	Front fuselage	Cabin door external view (*Detail* A) CUT HERE FOR RESCUE close to segmented line; FIRST AID & AXE STOWED INSIDE between shaft outline and door edge.
5	Front fuselage	Ejection seat warning standard symbol. See Detail A for location, Detail D for dimensions.
6	Centre fuselage	Refuelling point. Standard symbol, 1.50 in. x 1.50 in with 0.25 in lettering and spacing.
7	Centre fuselage	D.T.D. paint specification, 1 in. lettering.
8	Rear fuselage	Roundels.
9	Rear fuselage	Serial number. Letters and figures in black 24 in. high and 15 in. wide x 3 in. stroke with 2 in. gap.
10	Fin	Aerial cover. Paint dark green D.T.D. 900/4153.
11	Fin	Slinging points. Standard symbols, 1.50 in. across base.
12	Fin	National markings, 72 in. long x 24 in. wide.
13	Fin and rudder	D.T.D. paint specification markings. 1 in. lettering.
14	Fin	Tail plane incidence calibration lines, 0.2 in. thick (*Detail* C).
15	Underwing tank nose cap	LOCK (*Detail* B), Arrow points forward.
16	Underwing tank nose cap	Pneumatic point. 450 LB/SQ. IN. 32KGMS/SQ. CM. MAX. below standard symbol. NITROGEN 1800 LB/SQ. IN. 126.5 KGMS/SQ. CM. below standard symbol.

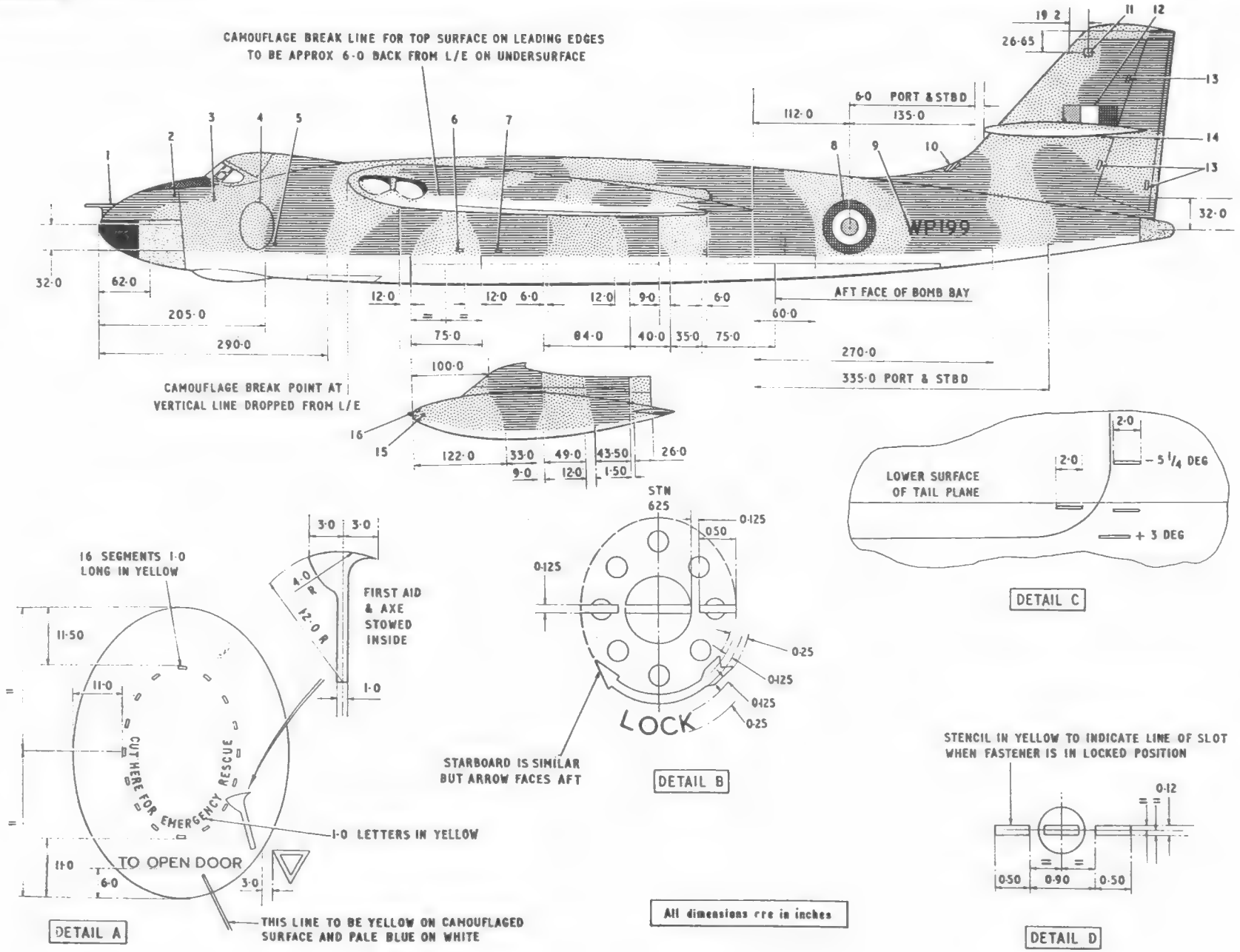


External markings (1)



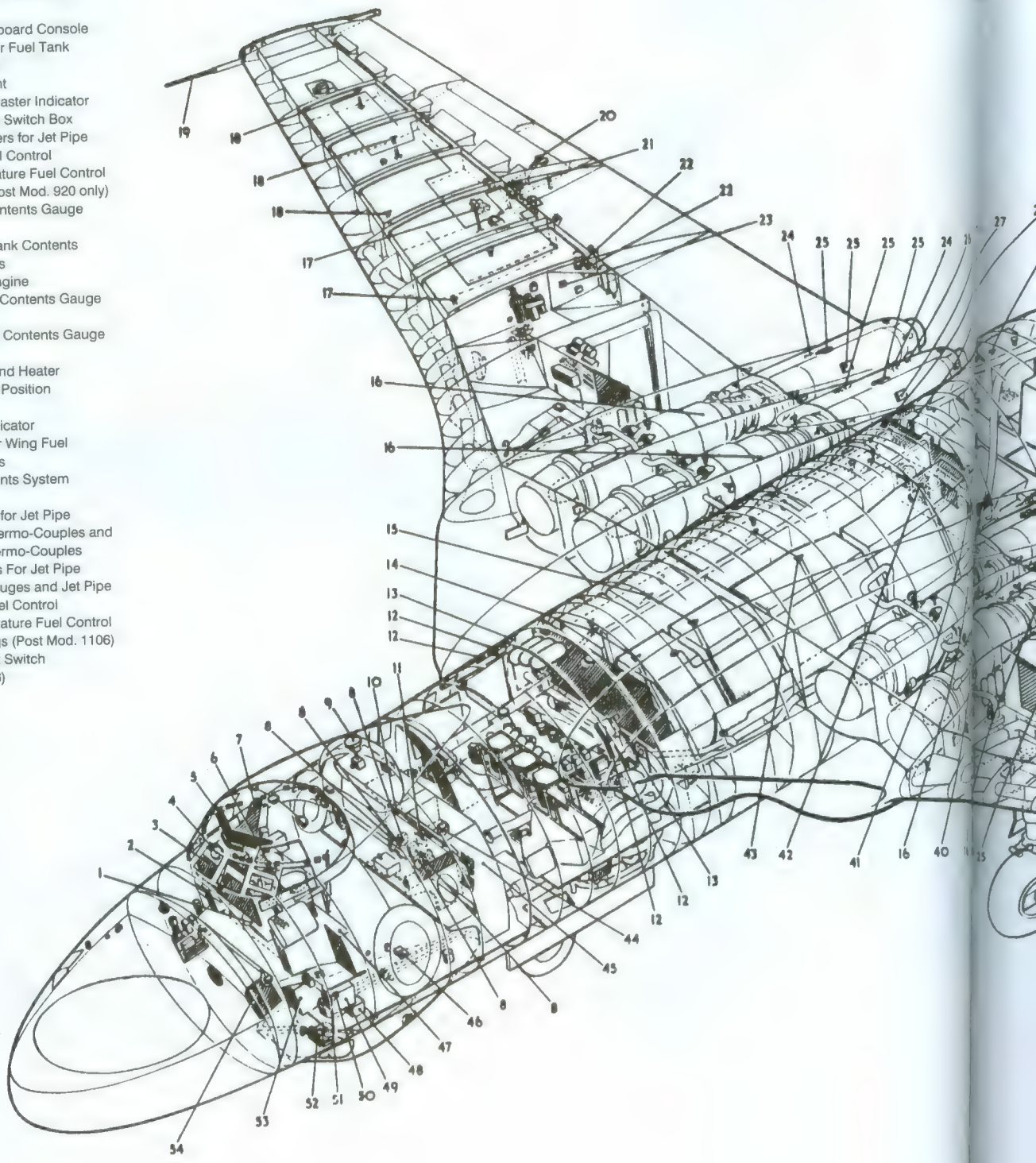
External markings (1), camouflaged aircraft

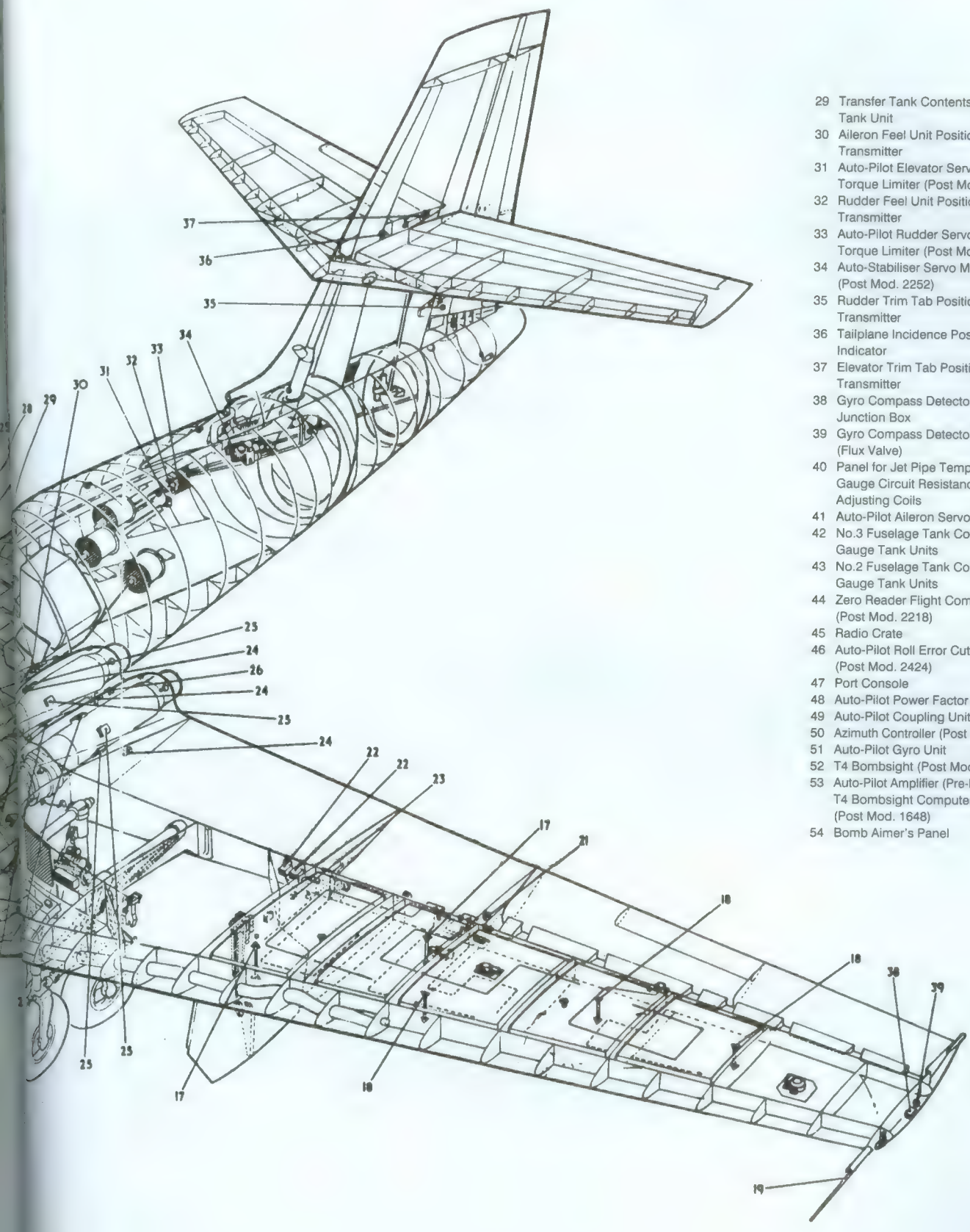



CAMOUFLAGE BREAK LINE FOR TOP SURFACE ON LEADING EDGES
TO BE APPROX 6·0 BACK FROM L/E ON UNDERSURFACE
WP199
AFT FACE OF BOMB BAY
CAMOUFLAGE BREAK POINT AT
VERTICAL LINE DROPPED FROM L/E
335·0 PORT & STBD
DETAIL A
16 SEGMENTS 1·0
LONG IN YELLOW
FIRST AID
& AXE
STOWED
INSIDE
CUT HERE FOR EMERGENCY RESCUE
TO OPEN DOOR
1·0 LETTERS IN YELLOW
THIS LINE TO BE YELLOW ON CAMOUFLAGED
SURFACE AND PALE BLUE ON WHITE
DETAIL B
STARBOARD IS SIMILAR
BUT ARROW FACES AFT
LOCK
DETAIL C
LOWER SURFACE
OF TAIL PLANE
+ 3 DEG
All dimensions are in inches
STENCIL IN YELLOW TO INDICATE LINE OF SLOT
WHEN FASTENER IS IN LOCKED POSITION
DETAIL D

Vickers Valiant Cutaway Drawing

1 Control Pedestal
2 Port Console
3 Pilot's Instrument Panel
4 Compass (Magnetic) (Pre-Mod. 2218)
5 Pilot's Fuel Panel
6 Auto-Pilot Instinctive Cut-out Switch
7 Panel above Starboard Console
8 Oscillator Units for Fuel Tank Contents Gauges
9 Periscopic Sextant
10 Gyro Compass Master Indicator
11 Auto-Pilot Torque Switch Box
12 Magnetic Amplifiers for Jet Pipe Temperature Fuel Control
13 Jet Pipe Temperature Fuel Control Isolating Relay (Post Mod. 920 only)
14 Reserve Tank Contents Gauge Tank Units
15 No.1 Fuselage Tank Contents Gauge Tank Units
16 Equipment on Engine
17 Inner Wing Tank Contents Gauge Tank Units
18 Outer Wing Tank Contents Gauge Tank Units
19 Pressure Head and Heater
20 Aileron Trim Tab Position Transmitter
21 Flap Position Indicator
22 Rectifier Units for Wing Fuel Contents Gauges
23 Wing Fuel Contents System Junction Box
24 Terminal Blocks for Jet Pipe Temperature Thermo-Couples and Fuel Control Thermo-Couples
25 Thermo-Couples For Jet Pipe Temperature Gauges and Jet Pipe Temperature Fuel Control
26 Jet Pipe Temperature Fuel Control Engine Test Plugs (Post Mod. 1106)
27 E.L. Fusing Pitot Switch (Post Mod. 1196)
28 Panel V





29 Transfer Tank Contents Gauge Tank Unit
30 Aileron Feel Unit Position Transmitter
31 Auto-Pilot Elevator Servo Unit and Torque Limiter (Post Mod. 2181)
32 Rudder Feel Unit Position Transmitter
33 Auto-Pilot Rudder Servo Unit and Torque Limiter (Post Mod. 2181)
34 Auto-Stabiliser Servo Motor (Post Mod. 2252)
35 Rudder Trim Tab Position Transmitter
36 Tailplane Incidence Position Indicator
37 Elevator Trim Tab Position Transmitter
38 Gyro Compass Detector Unit Junction Box
39 Gyro Compass Detector Unit (Flux Valve)
40 Panel for Jet Pipe Temperature Gauge Circuit Resistance Adjusting Coils
41 Auto-Pilot Aileron Servo Unit
42 No.3 Fuselage Tank Contents Gauge Tank Units
43 No.2 Fuselage Tank Contents Gauge Tank Units
44 Zero Reader Flight Computer (Post Mod. 2218)
45 Radio Crate
46 Auto-Pilot Roll Error Cut-out (Post Mod. 2424)
47 Port Console
48 Auto-Pilot Power Factor Unit
49 Auto-Pilot Coupling Unit
50 Azimuth Controller (Post Mod. 2140)
51 Auto-Pilot Gyro Unit
52 T4 Bombsight (Post Mod. 1648)
53 Auto-Pilot Amplifier (Pre-Mod. 1648) T4 Bombsight Computer (Post Mod. 1648)
54 Bomb Aimer's Panel

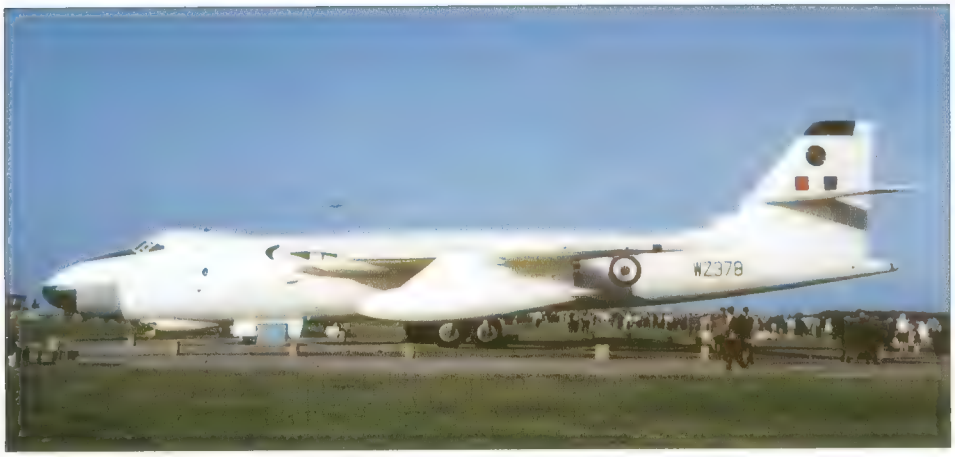
Valiants in Colour

Above and opposite page: **XD816 was resparred to investigate the feasibility of refitting the whole fleet and, as a result, continued flying after the main force was grounded. It operated for a period with 214 Squadron before joining BAC for fatigue flight trials in 1967. XD816 is here seen making a low-level flypast, and then landing, at Wisley in May 1967. Note the lowered flaps.** BAe Systems

Below: **XD822, a BK Mk.1 from 49 Squadron, is seen at dispersal, probably at RAF Marham.** BAe Systems

Vickers Valiant B Mk.1 WZ372, wearing the fin marking of 18 Squadron . Via Tony Buttler

Vickers Valiant B Mk.1 WZ368, at Benson during 1959, while serving with 232 OCU.
P H T Green collection



Vickers Valiant B Mk.1 WZ378 of the Honington-based 7 Squadron at Waddington's Battle of Britain Day during September 1961.
P H T Green collection

This is a 148 Squadron BK Mk.1 demonstrating at the September 1960 SBAC Show at Farnborough.
P H T Green collection

XD816 caught on camera about to touchdown at Wisley after performing at the RAF Abingdon air display in June 1968.

XD816 seen at Scampton on 30th April 1968 at the Bomber Command Stand-down ceremony, having completed fatigue flight trials with BAC. C J Salter

Second prototype WB215 seen on 25th September 1953 flying with drop tanks during preparations for the New Zealand Air Race.

WB215's RATOG units are given a trial running on the ground. BAE Systems

Top left: **7 Squadron B Mk.1 WZ378, climbs away from Waddington in September 1961.** P H T Green collection

Top right: **Valiant BK Mk.1 XD828, in camouflage colours, makes a fly-by at Waddington in September 1964.** P H T Green collection

Above: **BK Mk.1 XD825 seen in low-level camouflage on dispersal at Wisley.** BAe Systems

Right: **The Final Flight. The crew get ready for the last flight of the Valiant from Wisley – XD816 to RAF Abingdon for the RAF's 50th Anniversary celebration on 13th to 14th June 1968. The nose of this aircraft is now (2002) located in the Stratospheric Chamber at Brooklands Museum. The pilot on this occasion was Weybridge's test pilot, 'Jock' Cochrane (second from right) who has just received the operation order for the flight.**

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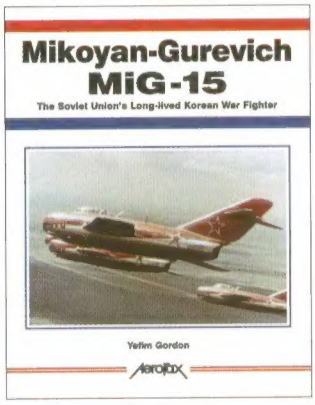

In this Aerofax, compiled from a wealth of first-hand Russian sources, there is a comprehensive history of every evolution of the Soviet Union's swept-wing fighter and its service. Notably in this volume, there are tables listing intricate details of many individual aircraft, a concept which would have been unthinkable in any publications only a few years ago.

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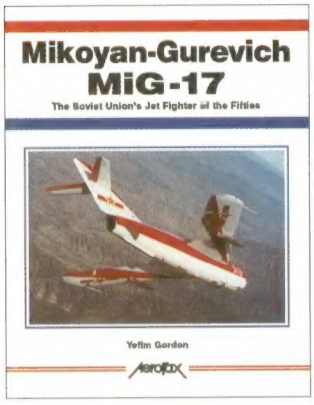

The Soviet Union produced and used around 9,000 MiG-17s. First flown in January 1950, it is an extensively upgraded MiG-15 with a redesigned 'scimitar' wing and lengthened fuselage.

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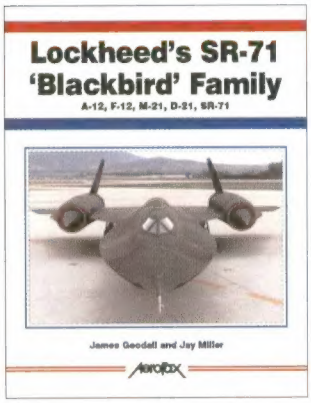
James Goodall and Jay Miller



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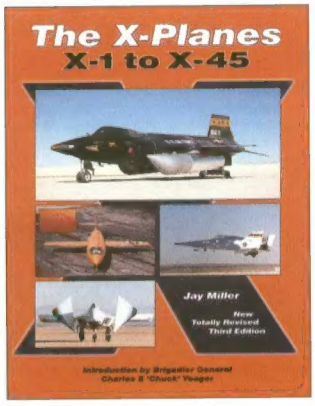

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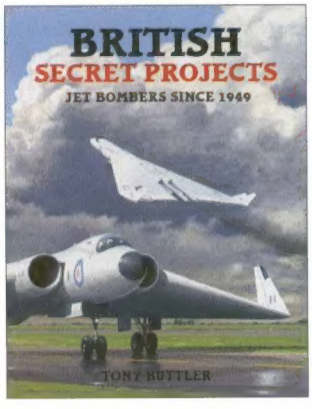

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Top: **Vickers Valiant prototype WB215 comes in to land at a Farnborough Air Show.** Eric Morgan Collection

Above: **148 Squadron's WZ367 on display at RAF Marham in 1964.** BAe Systems

Front cover illustration:
XD816 flying over Wisley after the Abingdon display in June 1968.

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